Formatted: Font: 18 pt, Bold

THESIS

FOR THE AWARD OF DEGREE OF

DOCTOR OF MEDICINE

SESSION 2020-2023

ETIOPATHOLOGICAL SPECTRUM OF ANAEMIA IN WOMEN OF REPRODUCTIVE AGE GROUP.

Dr. TAHSEEN GANI

Deemed to be Santosh University

No.1, Santosh Nagar,

Ghaziabad- 201009, NCR, India.

Formatted: Font: 18 pt, Bold

DEPARMENT OF PATHOLOGY

SANTOSH MEDICAL COLLEGE AND HOSPITAL

GHAZIABAD NCR, DELHI

COPY RIGHT CERTIFICATE-DECLARATION BY THE CANDIDATE

I hereby declare that Santosh University, Ghaziabad, (U.P.) shall have the right to preserve, use and disseminate this thesis titled **"ETIOPATHOLOGICAL SPECTRUM OF ANAEMIA IN WOMEN OF REPRODUCTIVE AGE GROUP"** in print or electronic format, for academic or research purpose.

Signature of Candidate:

Date:

Place:

Formatted: Font: 18 pt, Bold

CERTIFICATE BY THE GUIDE

This is to certify that the thesis titled **"ETIOPATHOLOGICAL SPECTRUM OF ANAEMIA IN WOMEN OF REPRODUCTIVE AGE GROUP"** will be bonafide genuine research work carried out by **Dr. TAHSEEN GANI** in partial fulfilment of the requirements for award of the degree of M.D. in the speciality of PATHOLOGY.

Guide

Dr. PREM K GARG MD
Designation
Professor & HOD
Department of pathology
Saraswathi Institute of Medical Sciences
HAPUR (U.P.), India.

Formatted: Font: 18 pt, Bold

CERTIFICATE BY THE CO-GUIDE

This is to certify that the thesis titled **"ETIOPATHOLOGICAL SPECTRUM OF ANAEMIA IN WOMEN OF REPRODUCTIVE AGE GROUP"** will be bonafide genuine research work carried out by **Dr. TAHSEEN GANI** in partial fulfilment of the requirements for award of the degree of M.D. in the speciality of PATHOLOGY.

Co-Guide

Dr. MAYURIKA TYAGI, MD
Designation
Associate Professor
Department of Pathology
Santosh Medical College & Hospital Ghaziabad
(UP), India.

Formatted: Font: 18 pt, Bold

CERTIFICATE BY THE CO-GUIDE

This is to certify that the thesis titled **"ETIOPATHOLOGICAL SPECTRUM OF ANAEMIA IN WOMEN OF REPRODUCTIVE AGE GROUP"** will be bonafide genuine research work carried out by **Dr. TAHSEEN GANI** in partial fulfilment of the requirements for award of the degree of M.D. in the speciality of PATHOLOGY.

Co-Guide

Dr. NEELIMA AGARWAL MS
Designation
Associate Professor
Department of Obstetrics and gynecology
Santosh Medical College & Hospital Ghaziabad
(UP), India.

Formatted: Font: 18 pt, Bold

CERTIFICATE BY THE HEAD OF THE DEPARTMENT

This is to certify that the thesis titled **"ETIOPATHOLOGICAL SPECTRUM OF ANAEMIA IN WOMEN OF REPRODUCTIVE AGE"** will be bonafide research work carried out by **Dr. TAHSEEN GANI** in partial fulfilment of the requirements for award of the degree of M.D. PATHOLOGY will be based on bonafide work carried out by her under my guidance and supervision and is completed to my full satisfaction.

PROF. (Dr.) RAJIV GUPTA

Designation

M.B.B.S., M.D.

Professor & HOD
Department of Pathology
Santosh Medical College & Hospital
Ghaziabad – 201001 (U.P)

Formatted: Font: 18 pt, Bold

SANTOSH
Deemed to be University
(Established u/s 3 of the UGC Act, 1956)

ENDORSEMENT BY THE DEAN OF THE COLLEGE

This is to certify that the thesis titled **"ETIOPATHOLOGICAL SPECTRUM OF ANAEMIA IN WOMEN OF REPRODUCTIVE AGE GROUP"** will be a bonafide research work carried out by **Dr. TAHSEEN GANI** Santosh Medical College and is presented before the ethical committee of Santosh University, Ghaziabad for requisite approval.

Dr ALKA AGRAWAL

Dean
Faculty of Medical Sciences
Santosh Medical College & Hospital
Santosh University
Ghaziabad – 201001 (U.P)

Formatted: Font: 18 pt, Bold

SANTOSH
Deemed to be University
(Established u/s 3 of the UGC Act, 1956)

ANTIPLAGIARISM DECLARATION/ UNDERTAKING

I, Dr. Tahseen Gani hereby declare that the present thesis entitled "ETIOPATHOGENESIS OF ANAEMIA IN WOMEN OF REPRODUCTIVE AGE GROUP" submitted by me to Santosh University is an original research work. I also declare that there is a similarity in content of 3%,after plagiarism check and the present thesis has not been submitted for the awardof degree/ diploma of the same institution or to any other institution, where the work was carried out.

Dr. Tahseen Gani

I, have verified the contents of the thesis and it is showing 3% similarity in

plagiarism check

PROF. (Dr.) RAJIV GUPTA

Professor & HOD
Department of Pathology
Santosh Medical College & Hospital
Ghaziabad – 201001 (U.P)

Dr JYOTI BATRA

Dean research & professor
Department of Biochemistry
Santosh Medical College& Hospital
Ghaziabad_201001(UP)

Formatted: Font: 18 pt, Bold

ACKNOWLEDGEMENT

I express my deep sense of gratitude and indebtedness to my most respected guide and teacher, Dr. Prem K Garg, Professor & HOD, Department of Pathology, Saraswathi Institute of Medical Sciences, Hapur for his constant help, valuable advice, inspirational demeanour and able guidance throughout the study. His ever-willing keenness to help and guide was a constant source of inspiration to me.

I heartily thank Dr. Mayurika Tyagi, Associate Professor, Department of Pathology, Santosh Medical College and Hospital, Ghaziabad for their help, valuable advice and suggestions. I owe my sincere thanks to Dr. Rajiv Gupta, Professor and Head of Department of Pathology, Santosh Medical College and Hospital, Ghaziabad for his suggestions and guidance. My sincere thanks to Dr. Swati Singh, Associate Professor, Department of Pathology, Santosh Medical College and Hospital, Ghaziabad for her help and support.

I would like to thank my parents, Mr Abdul Gani and Mrs Haleema Jan, my loving brother Dr Mohsin Gani for being the source of inspiration for me. I thank the ever-helpful postgraduates and all the technical and non-technical staff members of the department for their help.

I am grateful to Dr. Alka Agrawal, Dean, Santosh Medical College and Hospital, Ghaziabad. Last, but not the least, I would like to express my love and thanks to my husband Dr Waseem Ashraf for being there for me always.

Above all, I thank the Almighty and all the patients without whom this study would not have been possible.

Formatted: Font: 18 pt, Bold

INTRODUCTION

Worldwide, a significant major public health problem is anaemia and estimated that around 2 billion people are affected, which makes up ~~a major public health problem is anaemia and estimated around 2 billion people are affected which makes~~ 30% of the world's population~~,~~ (DeMayer& AdielsTegman, 1985~~),);~~ the majority come from the developing world. Infants, preschool children, infants ~~and~~ adolescents~~,~~ and women of childbearing age, particularly pregnant women~~,~~ are at the greatest risk of developing anaemia.~~-~~ 56% of pregnant women in developing countries and 18% in ~~the~~ developed countries ~~are anaemic,~~ and 50%-60% pregnant women are in Africa (WHO, 1992) are anaemic. ~~Fort~~The estimated prevalence is 43% and 12% of non-pregnant women in the developing and developed countries, respectively (WHO, 1992). There~~—~~ are multiple causes of anaemia, but iron deficiency is the most important cause of nutritional anaemia worldwide (DeMayer et al., 1989).~~-~~ The iron requirement increases in women from puberty to menopause~~,~~ due to the physiological requirements of menstruation, pregnancy and~~,~~ lactation. For this reason, ~~iron deficiency is common in women of reproductive age even in developed countries (Katai et al., 1996; Milman et al., 1993), during their reproductive years~~during their reproductive years, iron deficiency is common in women of reproductive age even in developed countries (Katai et al., 1996; Milman et al., 1993).~~-~~ P~~p~~regnant women have increased demand due to the physiological increase in maternal red blood cell mass~~,~~ and the need ~~of~~ for the growing foetus and placenta.~~-~~ The ~~-~~growth spurt ~~increases~~ during adolescence and an increase due to regular menstrual loss for girl, their need for iron increases. ~~because of the need for iron, and, for the girl, there is increase due to regular menstrual loss.~~ In ~~the~~ developing countries, the high iron demand in these groups is not met, mainly because of the poor diet of low iron bio-availability ~~,~~ and frequent parasitic infections, thus leading to a high incidence of anaemia in girls~~women~~ and women~~girls~~. An adolescent who ~~if~~ conceives soon after menarche is likely to start pregnancy with depleted stores.~~-~~ In developing countries, adolescent pregnancies are common and anaemia is one of the serious health problems for the girls (Arkutu, 1979; Brabin et al., 1998). Too many pregnancies that are closely spaced can put a heavy nutritional demand on the woman who, after a pregnancy

and lactation, has no time for physiological recovery before a subsequent pregnancy (Fleming, 1989b)[1]

One of the most important concerns in India is the p~~P~~oor nutritional status of reproductive age women. Poor nutritional status is an indication of insufficient intake of energy and nutrients to maintain good health. Unfortunately, India ranks 101 out of 116 qualifying countries with a score of 27.5 in terms of hunger index 2021 (Grebmer et al., 2021). It is agreed~~, that the prevailing culture and traditional practices in India, during pregnancy and lactation is a major factor in the prevailing poor nutritional status of reproductive age women~~ that the prevailing culture and traditional practices in India, during pregnancy and lactation~~, is~~ are major factors in the poor nutritional status of women of reproductive age. According to the National Family Health Survey, 2015-16 (NFHS-4) 53 % of the reproductive age women; 50% of pregnant women ~~;~~and 58 % of lactating mothers are anaemic (International Institute for Population Sciences and ICF, 2017).[2]

One of the most important micronutrient deficiency disorders is anaemia ~~not only in India but~~in India and globally. It is an indicator of micronutrient malnutrition leading to poor health status among all age groups, especially vulnerable to high-risk group such as pregnant women. Despite various efforts ~~our community is still facing~~, our community still faces ~~this~~ the challenge for running nutritional program~~me~~s by the Government of India. Studies from urban areas of the State~~,~~ Uttar Pradesh, regarding anaemia during pregnancy are very few, although the consequences are much more.[3]

Globally anaemia is the third largest contributor to total disability adjusted life years (DALYs), especially among women in the reproductive age group (15–49 years).[4]

One of the ~~study~~ studies revealed the overall prevalence of anaemia among pregnant women as 78.7% [5]. As per data of DLHS-3 (District Level Household and facility Survey-3), 2005, the prevalence of anaemia during pregnancy in India, had been estimated as 87%.[6] ~~This result is found to be less than that of prevalence of anaemia during pregnancy in India, as per data of DLHS-3 (District Level Household and facility Survey-3), 2005, which had been estimated as 87%.~~[6]

Formatted: Font: 18 pt, Bold

Formatted: Font: 18 pt, Bold

This high prevalence of anaemia is observed as similar to the earlier studies by Khan et al. at rural communities attached with RHTC, Rama Medical College, Ghaziabad (January 2014) (80%),]~~.~~[7] by Piyush et~~-~~ al (Jan - Mar 2014) at Index Medical College, Hospital (62.7%), [8]~~-~~ by Singh et al. (2009) at Dehradun (65.5%).[9] "Indian Council of Medical Research (ICMR) Task Force Multicentre Study" revealed that the overall prevalence of anaemia among pregnant women from 16 districts was 84.9%. [9]

Anaemia is ~~a condition characterized~~ characterised by a decrease in the concentration of haemoglobin in the blood. Haemoglobin is necessary for transporting oxygen to tissues and organs in the body. The reduction in oxygen available to organs and tissues when haemoglobin levels are low is responsible for many of the symptoms experienced by anaemic people. The consequences of anaemia include general body weakness, frequent tiredness~~,~~ and lowered resistance to disease. Anaemia can be a serious problem for pregnant women, leading to premature delivery and low birth weight. Overall, morbidity and mortality risks increase for individuals suffering from anaemia. Haemoglobin estimation is the primary method for the diagnosis of anaemia. Based on concentration of haemoglobin in the blood, anaemia is classified into three groups as mild, moderate or severe. [1]

Mild anaemia- Mild anaemia corresponds to a level of haemoglobin concentration of 10~~9~~.0-10~~0~~.9 gm/dl for pregnant women, and 11~~9~~.0-11.9 gm/dl for non-pregnant women. Women with mild anaemia in pregnancy have decreased work capacity. They may be unable to earn their livelihood if the work involves manual labour.

Moderate anaemia- Moderate anaemia corresponds to a haemoglobin level of 87.0-108.9 gm/dl for non pregnant women and 9.9-7.0gm/dl for pregnant women. Women with moderate anaemia have a substantial reduction in work capacity and may find it difficult to cope with household chores and child care. Available data from India and elsewhere indicate that maternal morbidity rates are higher in women with Hb below 8 gm/dl. They are more susceptible to infections, and recovery from infections may be prolonged. Premature births are more common in women with moderate anaemia. They deliver infants with lower birth weight and perinatal mortality is higher in these babies.

Severe anaemia- Severe anaemia is <8.0gm/dl for non pregnant women and 7.0gm/dl for pregnant women. For all of the tested groups, severe anaemia (<7.0gm/dl) is mostre dangerous. Severe anaemia is important because it indicates that there may be one or more serious nutritional deficiencies or an underlying medical problem that requires thorough assessment and treatment. Clinicopathological patterns of anaemia in women of reproductive age group is often reflected by their underlying etiopathogenetic factors. A thorough history elicitation, physical examination, complete hemogram including examination of peripheral smear, reticulocyte count and the required biochemical investigations would be the starting point for evaluation. The present study is done to evaluate the haematological and biochemical parameters to aid in understanding the clinicopathological patterns of anaemias and their causes. The study will determine patterns and various morphological types of anaemias in reproductive age group in women.

Anaemia is a global problem affecting persons of all ages. It results in reduced oxygen-carrying capacity of RBCs which will cause chronic fatigue and ill health. Pallor, low blood pressure, headache, and oedema are the most common manifestations of anaemia. Moreover, general clinical findings may be characteristically associated with a specific type of anaemia. Globally, anaemia affects 24.8% of the population.[2] Non-pregnant reproductive-aged women were the third most affected group, next to pPre-school-aged children and pregnant women. According to 2011 report, globally, the prevalence of anaemia among non-pregnant reproductive-aged women was 29% with 1.1% of them being severely anaemic. Report The report showed that the prevalence of anaemia in East Africa was 28%, of which 1.2% were classified as severe anaemia.[3] Based on the Ethiopian

Formatted: Font: 18 pt, Bold

Comment [M1]: k

Comment [tG2]: .

Comment [tG3]:

Comment [tG4]:

Formatted: Font: (Default) Times New Roman, 12 pt

Demographic and Health Survey (EDHS) 2016 report, the prevalence of anaemia among reproductive age women in Ethiopia was 23%. Anaemia has a number of causes, with the most significant cause being iron deficiency.

Approximately 50% of cases of anaemia are caused by iron deficiency, but the proportion probably varies across population groups and in different geographical areas, based on the local conditions. In this regard, a systematic analysis of national surveys revealed that iron deficiency contributes to 37.0% of anaemic cases. Other causes of anaemia include other micronutrient deficiencies like folate, riboflavin, vitamins A and B12, acute and chronic infections and inherited or acquired disorders of haemoglobin synthesis, red blood cell production or survival alterations.[4] It Aanaemia is more common in women due to the loss of iron during menstruation, and high demand throughout pregnancy and puberty.

Deprived nourishment, detrimental eating lifestyle, parasitic infestations, particularly malaria and hookworm infestation and rural residence are other contributing factors to the prevalence of anaemia among women.[5] Based on its public health problem, anaemia can be categorized categorised as follows: greater than 40%, 20–39%, and 5–19%, corresponding to severe, moderate, and mild public health problems respectively.[6]

Hb measurement plays a vital role in the diagnosis of anemia since it is inexpensiveand easy to diagnose anemiadiagnosing anemia since it is inexpensive and easy to diagnose.

When anaemia is suspected, a complete blood cell count (CBC) should be performA complete blood cell count (CBC) should be performed when anaemia is suspected. With the help of Mean corpuscular volume (MCV), anaemia can be placed into one of the standard classifications of normocytic, microcytic, and macrocytic types.

Based on morphology of red cells in peripheral smear, aetiology of anaemia can be narrowed down further. Basophilic stippling representing aggregated ribosomes can be seen in thalassemia syndromes, iron deficiency and lead poisoning. In cases of asplenia, pernicious anaemia and severe iron deficiency, Howell-Jolly bodies (nuclear remnants) are seen. Cabot's ring bodies are also nuclear remnants and are seen in lead toxicity, pernicious anaemia, and haemolytic anaemias.

Formatted: Font: 18 pt, Bold

Formatted: Justified

Heinz bodies (denatured aggregated haemoglobin) can be seen in thalassemia, asplenia and chronic liver disease. The reticulocyte count helps distinguish a hypo-productive marrow from a destructive process. Bone marrow disorders or aplastic ~~crisis~~ crises is~~n~~ indicated when the reticulocyte count is low, while a high count generally indicates a haemolytic process or an active blood loss. A better ~~8~~ indicator of erythropoietic activity is corrected reticulocyte count; which when more than 1.5 is suggestive of increased RBC production. After the analysis of the initial laboratory findings, if the diagnosis is still not clear, other confirmatory studies may be required. Serum iron level, serum ferritin level, total iron binding capacity (TIBC) and lead level estimation can be done to determine if the MCV is too low. Serum ferritin levels are both sensitive and specific for iron deficiency and are first to decrease as well. However, being an acute phase reactant, serum ferritin alone cannot be relied upon as it ~~they~~ can be falsely elevated. Direct Coomb's test, G6PD assay, haemoglobin electrophoresis, lactate dehydrogenase (LDH), haptoglobin and bilirubin (indirect) determination may help to confirm haemolysis, if suspected. If MCV is elevated, vitamin B12, folate and thyroid stimulating hormone (TSH) levels should be estimated.[3,4] Other tests for the confirmation of diagnosis include~~,~~ RBC enzyme panel, osmotic fragility test, haemoglobin isoelectric focusing, membrane protein studies and cytogenetic studies to diagnose enzymopathies, hereditary spherocytosis, hemoglobinopathies, membranopathies, respectively. A detailed history, physical examination of the patient, complete hemogram along-with peripheral blood picture examination and the required biochemical investigations would help in starting the evaluation. The present study is to evaluate the haematological and biochemical parameters to aid in understanding the clinicopathological patterns of anaemias and their causes~~.~~ The current study is being carried out to determine the prevalence, patterns and various morphological types of anaemias.~~.~~

Formatted: Font: 18 pt, Bold

Comment [M5]: ?

Formatted: Superscript

Formatted: Font: 18 pt, Bold

Formatted: Font: 18 pt, Bold

AIMS AND OBJECTIVES

1. To detect the ~~etiologicaland~~ morphological types of anemia prevalent among women of reproductive age group.
2. To detect the severity of anemia among women of reproductive age group.

Comment [M6]:

REVIEW OF LITERATURE

Anaemia is defined as a reduction in red cell mass or blood haemoglobin(Hb%) concentration below the normal values for that age and sex of the persons.[7] Globally, 41.8% of pregnant women and 30.2% of non-pregnant women are anaemic.

A study was done in women of reproductive age group in Sayint Adjibar town in northeast Ethiopia. In this study, educational status was found to be significantly associated with the prevalence of anaemia among study participants. Reproductive age women with no formal education were more likely to be anaemic as compared to those having secondary and above educational status. Odds The odds of to bebeing anaemic in this study was were 2.28 times higher in women with no formal education than in women attending secondary and above educational status. This is supported by studies conducted in Ethiopia,[8] that low educational status was a key predisposing factor of for women to be anaemic,; reason might be because the provision of education enables people to earn or increase their earnings so as to get out of the poverty trap. It is important to bring sustainable and effective poverty reduction. In fact, anaemia by its nature is related to nutritional deficiencies, and in turn, nutritional deficiency has been directly related to poverty which leads to the onset of anaemia. Education also directly impacts health and nutritional status.

Another In a nother study done in Vietnam, multicausal aetiology of anaemia among women of reproductive age, in Vietnam, bBivariate analysis indicated that iron intakes were low but did not differ by anaemia status, whereas the contribution from meat and vitamin A and B12 intakes was significantly lower among those with anaemia compared with those without .(results not shown). Low education was also significantly associated with an increased risk for anaemia in the adjusted model. In contrast, vitamin A deficiency and hookworm infection were no longer significantly associated with anaemia in the multivariate logistic but were significantly associated with increased odds of low iron stores. It was found that hookworm infection, a known risk factor for anaemia and iron deficiency,[9]] was directly associated with iron status and indirectly associated with haemoglobin through ferritin.

Formatted: Font: 18 pt, Bold

Formatted: Centered

Formatted: Centered, Space Before: 0 pt, Line spacing: Multiple 1.08 li

Formatted: Justified

Comment [M8]: g

Comment [M9]: keep uniform format for references. Brackets or no brackets

Formatted: Font: (Default) Times New Roman, 12 pt

Comment [M10]: unclear sentence

Comment [M11]: format of reference

Another study was done ~~at~~ in Nepal~~, for determining~~to determine factors for the prevalence of anaemia in women of reproductive age group and it was noted that two of the five women of reproductive age were anaemic. Anaemia must be considered as a severe public health problem given the high prevalence (over 40%) identified in this study.[10] ~~The prevalence of anaemia revealed by this study is higher than both the national average (35.1%), and the world average (32.8%). On the other hand,~~ some cross-sectional studies showed that the relatively low prevalence of anaemia among younger women (aged 13–35 years) in Nepal could be due to the selection of healthy women living in an urban setting and non-endemic areas for malaria and hookworm infestation.[11]

~~In a~~A study carried out among youths in a rural block of Haryana by Verma R et al. recorded that 44.38% of females were mildly anaemic, 13.9% were moderately anaemic, and 2.67% were severely anaemic.[12]

Bulliy ~~y~~et al. found 96.5% prevalence of anaemia among non-school going adolescent girls in three districts of Orissa, of which, 45.2%, 46.9%, and 4.4% had mild, moderate, and severe anaemia.[13] The high prevalence of mild and moderate anaemia demands ~~due~~ emphasis on iron and folic acid supplementation and health education on the consumption of iron rich foods, ~~so as~~ to conclude the total prevalence of anaemia among women of reproductive age group. This study revealed that anaemia is a major public health problem among the w~~W~~omen of reproductive age ~~group of~~in rural settings. The study also added that anaemia was more prevalent in child bearing age.

In a cross-sectional study of anaemia among women of reproductive age group done in a rural population of Tamil Nadu by Chellavel Ganapathi K et al~~, Sathish Kumar K~~[17] .di~~D~~istribution of anaemia by the age of the women was found to be statistically significant, and it was found that as the age increases, the risk of anaemia decreases. Few socioeconomic factors ~~such as~~include maternal occupation and menstruation, age at menarche, amount of menstrual bleeding, length of menstrual cycle, PID, number of live births, contraception use, pregnancy, and iron and folic acid (IFA) use were found to have statistically significant association with anaemia. Women who were underweight, taking a vegetarian diet, using an open field for defecation, and passed worms in their stools were found to have a statistically significant association with anaemia. Similarly, age at menarche 13-14 years, normal menstrual bleeding, taking mixed diet, regular wearing of footwear, taking deworming tablets recently (< 6 months) and using sanitary latrines were found to be

Formatted: Font: 18 pt, Bold

Comment [M12]: unclear.. u can use study by author etal.

Comment [M13]: Indian?? Or Nepal?? Clarify in writeup

Comment [M14]:

Comment [M15]: .

Comment [M16]: s

at lower risk of anaemia. Women who used any ~~type of contraception were at significantly lower risk of anaemia (49.0%) when compared to women who had not used any type of~~contraceptive were at a significantly lower risk of anaemia (49.0%) compared to women who had not used any contraceptive (61.5%). Women using intrauterine device were at higher risk of anaemia (59.6%) when compared to women who had undergone tubectomy (45.6%).

Another study by Damares Kimyoki et al[18] showed geospatial estimate of anaemia from 2000 to 2018 prevalence in women of reproductive age (15–49 years) across 82 low- and middle-income countries (LMICs), stratifying anaemia by severity and aggregate results to policy-relevant administrative and national levels. Results demonstrate moderate improvements in overall anaemia prevalence ~~but~~. However, they identify only three low and middle income countries~~LMICs~~ with a high probability of achieving the WHO GNT by 2030 at a national scale, and no low and middle income countries~~LMIC~~ is expected to achieve the target in all their subnational administrative units. This study is part of a series using high-spatial-resolution estimates to map progress toward the WHO GNTs[19],[20],[21]. To perform this study, an extensive geo-positioned dataset was made from 218 surveys representing over 3 million women. Using Bayesian model-based geostatistics and the assumption that locations with similar socioeconomic and environmental patterns and proximity in time and space would have similar anaemia levels., Tthe study produced estimates for all areas across 82 LMICs, even where data were sparse. The geospatial nature of study estimates also allows ~~to aggregate~~aggregating to different (and sometimes changing) boundaries and catchment areas over the observation period. Here the study presents annual geospatial estimates from 2000 to 2018 of prevalence and absolute counts of anaemia of women of reproductive age (non-pregnant and pregnant combined), stratified by severity and aggregated to first-level (for example, provinces) and second-level (for example, districts) administrative units and national levels across 82 low and middle income countries.~~LMICs~~[22].

~~Anaemia severity categories are defined by the WHO~~The WHO defines anaemia severity categories: mild anaemia (11.0–11.9 g dl^{-1} for non-pregnant women; 10.0–10.9 g dl^{-1} for pregnant women), moderate anaemia (8.0–10.9 g dl^{-1} for non-pregnant women; 7.0–9.9 g dl^{-1} for pregnant women) and severe anaemia (<8.0 g dl^{-1} for non-pregnant women; <7.0 g dl^{-1} for pregnant women). The results are discussed in light of public health problem thresholds: no public health problem (<5% overall anaemia prevalence), low public health

Formatted: Font: 18 pt, Bold

Comment [M17]:

Formatted: Superscript

problem (5–19.9% overall anaemia prevalence), medium public health problem (20–39.9% overall anaemia prevalence) and high public health problem (≥40% overall anaemia prevalence)[22]. These estimates can aid in focusing attention on exemplars of progress, highlighting subnational inequalities and identifying locations requiring further investments.

The prevalence of overall anaemia among women varied broadly across LMICs. In 2018, anaemia prevalence was highest in West African, Middle Eastern and South Asian countries, including Gambia (50.3% (95% uncertainty interval: 43.3–57.5)), Senegal (47.3% (43.4–50.1)), Mali (47.6% (45.8–49.4)), Yemen (57.4% (50.9–63.8)) and India (49.9% (47.2–52.4)). The lowest national-level anaemia prevalence in 2018 was found in Central America and the Caribbean, Andean South America and East Asia, including El Salvador (8.2% (3.6–16.1)), Colombia (9.2% (4.5–17.0)), Mexico (10.4% (7.3–15.3)) and China (11.1% (9.1–13.1)). Gradual declines on a global scale indicate that little progress was seen in reducing anaemia on a more local scale.

Another study done at Agha khan university Karachi Pakistan [23] in 2018 suggests that Iron deficiency anaemia is one of the important Public Health problems in developing countries among the women of reproductive age group. Multiple factors like age, parity, socioeconomic status and diet can affect the stores of iron in the women of reproductive age group. Anaemia can lead to multiple adverse outcomes, which can be prevented by taking appropriate cost-effective interventions on time. According to CDC (centre for disease control and prevention), "Iron deficiency is a condition resulting from too little iron in the body". If the iron supply is ~~not~~ inadequate, the haemoglobin (Hb~~B~~) production does not succeed and the number of red blood cells decreases [24] as iron is very important for the production of haemoglobin. Anaemia has been a ~~major~~ significant public health concern over the past few years. According to N Milman, "The most common nutritional deficiency in both developing as well as in developed countries is iron deficiency". Globally, similar to other diseases, poor countries and underprivileged groups suffer the most.

I~~i~~ron deficiency can be ~~categorized~~ categorised into three categories;

1. Mild Deficiency consists of depleted stores with normal production of Hb and iron-dependent protein.

Formatted: Font: 18 pt, Bold

Formatted: Font: Bold

Formatted: Font: 12 pt

Formatted: List Paragraph, Justified, Numbered + Level: 1 + Numbering Style: 1, 2, 3, … + Start at: 1 + Alignment: Left + Aligned at: 0.25" + Indent at: 0.5"

2. Marginal deficiency consists of depleted iron stores and decreased iron-dependent protein production but normal Hb concentrations.
3. Severe iron deficiency anaemia consists of a decreased concentration of circulating RBCs which results in decreased concentration of Hb within blood cells resulting in compromised transport of oxygen to tissues, iron stores are further depleted and the concentrations of iron-dependent oxidative enzymes are reduced [25].

Pregnant women and children are the most anaemic population ~~group~~ in poor countries as they have the least access to interventions and services. According to a report by World Bank on anaemia, "In women, anaemia prevalence decreases with income in every region/ country". Prevalence in the poorest as compared to the richest is twice high in many countries [26]. "Regardless of its aetiology, the World Health Organization (WHO) estimates that anaemia affects over 1.62 billion people worldwide. It affects pregnant women (41%), non-pregnant women (30%) and people older than 60 years of age (24%); men are the least selected group (12%). However, globally, the most numerous population group is non-pregnant women (468.4 million)" [27].

Classification of Anaemia:

The classification of anaemia is important, since anaemia can be caused by a variety of reasons and hence, the strategy to determine a final diagnosis begins with the classification.

- ~~A.~~ ***Etiopathogenic classification of Anemia*** [28]

1. Regenerative anaemia

a. Acute or chronic bleeding

b. Haemolytic anaemia

- Hereditary (hemoglobinopathy, enzymopathy, membrane–cytoskeletal defects)
- Acquired (autoimmune, mechanical destruction, toxic-metabolic, drugs, infectious)

2. Hypo-regenerative anaemia

I. Bone marrow failure caused by stem cell pathology

1. ~~a.~~ Quantitative disorder
2. Selective: erythroblastopenia
3. Global: aplastic anaemia

Formatted: Font: 18 pt, Bold

Formatted: Justified

Formatted: Justified

Formatted: List Paragraph, Bulleted + Level: 1 + Aligned at: 0.25" + Indent at: 0.5"

Formatted: Indent: Left: 0"

Formatted: Font: 12 pt

Formatted: Italian (Italy)

Formatted: List Paragraph, Numbered + Level: 1 + Numbering Style: 1, 2, 3, … + Start at: 1 + Alignment: Left + Aligned at: 0.59" + Indent at: 0.84"

4. ~~b.~~ Qualitative disorder (dysmyelopoiesis)
5. -Inherited: hereditary dyserythropoiesis
6. Acquired: myelodysplasia

II. Bone marrow infiltration

1. ~~a.~~ Leukaemia, lymphoma
2. ~~b.~~ Solid tumours
3. ~~c.~~ Myelofibrosis

III. Inflammatory chronic diseases, micro organisms

IV. Drugs, hypothyroidism, uraemia

V. Erythropoietic factors deficiency

1. ~~a.~~ Iron
2. -Iron deficiency anaemia
3. Anaemia of chronic disease
4. ~~b.~~ Cobalamin and folate deficiency
5. Megaloblastic anaemia
6. ~~c.~~ Hormones: erythropoietin, thyroid hormones, androgens, steroids

- ***~~B.~~ Morphological classification*** [28]

Pathogenic classification is ~~very important~~fundamental to understand the mechanisms involved in the genesis of anaemia. However, in daily clinical practice, it is more useful to start with the parameters of the hemogram. MCV allows us to classify anaemia as microcytic (MCV < 82 FL), normocytic (MCV = 82-98 FL) and macrocytic (MCV > 98 FL). MCV has a relationship with mean corpuscular haemoglobin (MCH), which reports on the mean haemoglobin per erythrocyte expressed in picograms (normal range: 27-32 pg.). Therefore, MCV and MCH decrease (microcytic, hypochromic anaemia) or increase (macrocytic, hyperchromic anaemia) jointly.[28]

1. Microcytic anaemia (MCV < 82fl) [28]

1. ~~a.~~ Iron deficiency anaemia
2. ~~b.~~ Thalassemia

Formatted: Font: 18 pt, Bold
Formatted: Font: 12 pt
Formatted: Font: 12 pt
Formatted: List Paragraph, Numbered + Level: 1 + Numbering Style: 1, 2, 3, … + Start at: 1 + Alignment: Left + Aligned at: 0.59" + Indent at: 0.84"
Formatted: Font: 12 pt
Formatted: List Paragraph, Numbered + Level: 1 + Numbering Style: 1, 2, 3, … + Start at: 1 + Alignment: Left + Aligned at: 0.59" + Indent at: 0.84"
Formatted: Font: 12 pt
Formatted: Font: 12 pt, Bold, Italic
Formatted: List Paragraph, Bulleted + Level: 1 + Aligned at: 0.25" + Indent at: 0.5"
Formatted: Justified
Formatted: Font: 12 pt
Formatted: List Paragraph, Numbered + Level: 2 + Numbering Style: 1, 2, 3, … + Start at: 1 + Alignment: Left + Aligned at: 0.59" + Indent at: 0.84"

3. ~~c.~~ Non thalassaemic conditions associated with microcytosis

- ACD (e.g., Rheumatoid arthritis, Hodgkin's Lymphoma, Chronic infection, Neoplasia)
- Sideroblastic anaemia (e.g., hereditary, lead poisoning)

2. Normocytic anaemia (MCV = 82-98 Fl) [28]

1. ~~a.~~ Nutritional anaemia
2. ~~b.~~ Anaemia of renal insufficiency
3. ~~c.~~ Haemolytic anaemia

- Red cell intrinsic causes: M~~m~~embranopathy, enzymopathy, hemoglobinopathy
- Red cell extrinsic causes: I~~i~~mmune-mediated, microangiopathic, associated with infection, chemical agent (spider venoms), metabolic

d. Anaemia of chronic disease~~ACD~~

e. Primary bone marrow disorder

3. Macrocytic Anaemia (MCV > 98fl) [28]

1. ~~a.~~ Drugs (Hydroxyurea, zidovudine, methotrexate)
2. ~~b.~~ Nutritional (Vitamin B12 and Folate deficiency)
3. ~~c.~~ Drug-induced haemolytic anaemia
4. ~~d.~~ Dyserythropoiesis, myelodysplastic syndrome, clonal hematologic disorder
5. ~~e.~~ Hereditary hematologic disorders

~~4.~~ **Mild macrocytosis (MCV = 100 - 110fl)** [28]

~~a. Reticulocytes~~

1. ~~a~~b. Excess alcohol intake, liver damage, smoking
2. ~~b~~c. Hypothyroidism, Waldenstrom's macroglobulinemia

Formatted: Font: 18 pt, Bold

Formatted: Portuguese (Brazil)

Formatted: List Paragraph, Numbered + Level: 2 + Numbering Style: 1, 2, 3, … + Start at: 1 + Alignment: Left + Aligned at: 0.59" + Indent at: 0.84"

Formatted: Font: 12 pt

Formatted: Font: 12 pt

Formatted: List Paragraph, Numbered + Level: 2 + Numbering Style: 1, 2, 3, … + Start at: 1 + Alignment: Left + Aligned at: 0.59" + Indent at: 0.84"

Formatted: Font: (Default) +Headings CS (Times New Roman)

Formatted: Font: (Default) +Headings CS (Times New Roman), 12 pt, Bold

Formatted: Font: (Default) +Headings CS (Times New Roman), 12 pt

Formatted: Font: 12 pt

Formatted: List Paragraph, Numbered + Level: 1 + Numbering Style: 1, 2, 3, … + Start at: 1 + Alignment: Left + Aligned at: 0.25" + Indent at: 0.5"

3. ~~c~~d. Copper deficiency, bone marrow aplasia, erythroblastopenic anaemia
4. ~~d~~e. Chronic obstructive pulmonary disease

- **C. Classification of Anaemia as RDW and MCV** [28]

1. Normal RDW and Low MCV

   a. β-thalassemia

   b. α-thalassemia

2. Normal RDW and High MCV

   a. Bone marrow aplasia

3. Increased RDW and Low MCV

   a. Iron deficiency

4. Increased RDW and High MCV

   a. Megaloblastic anaemia.

Johnson et al., in their study, showed that RDW appears to be a useful technique in the initial screening of the patient with microcytosis and helps to determine the type of ancillary investigations required. [29]

Furthermore, a study done by Oski suggested that, for iron deficiency screening, RDW is more sensitive than serum iron concentration. [30]

Formatted: Font: 18 pt, Bold

Formatted: Font: 12 pt, Bold

Formatted: List Paragraph, Bulleted + Level: 1 + Aligned at: 0.25" + Indent at: 0.5"

Formatted: Indent: Left: 0.5"

Formatted: Indent: Left: 0.5"

Comment [M18]: ..

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Justified

Kim et al. recommended that the predictive value of IDA can be increased to 98% if RDW and MCV are routinely determined. [31]

In conclusion, adequate iron intake is crucial for a healthy pregnancy. However, adequate nutrition may not be possible in many developing countries. Iron supplementation should be considered early in these cases. There is an increasing need for public health strategies to educate the population as ~~to~~about the need for a healthy diet and iron supplementation before conception, or at least at the beginning of the pregnancy. Integrating this information into educational curricula, pre-marital counselling, and prenatal care is needed. Mothers should receive appropriate nutritional advice and supplementation at their first point of contact with healthcare professionals.[32] The two most common causes of anaemia in pregnancy and the puerperium are iron deficiency and acute blood loss. Iron requirements increase during pregnancy, and a failure to maintain sufficient levels of iron may result in adverse maternal–fatal consequences. [33]

Evaluation of anaemia in women of reproductive age.

Aa detailed history, physical examination and essential laboratory tests are an initial diagnostic approach to anaemia and ~~it~~ should include~~,~~ determination of haemoglobin, haematocrit, red cell indices, platelet count, total white blood cell count, differential leucocyte count, reticulocyte count and examination of the peripheral blood smear.

The practical starting point in the classification of anaemia and laboratory evaluation of anaemia~~s~~ is complete blood count (CBC) ~~and~~ which consists of the estimation of haemoglobin, haematocrit, erythrocyte count, MCV, MCH, MCHC, leucocyte count, and platelet count.[34]

Haemoglobin: The most readily assessed parameter in diagnosing~~diagnosis of~~ anaemia is haemoglobin estimation. Anaemia is generally defined as an abnormal decrease in the concentration of haemoglobin and haematocrit levels or a decrease in the number of circulating erythrocytes that are two standard deviations below the mean for age in the normal population~~. In this study, the WHO standard cut-off points for anaemia and severe anaemia for women of reproductive age is used~~. AAny pregnant women with a haemoglobin level of less than 10~~1~~.0 g/dl~~l~~ are considered anaemic and with a haemoglobin level of less than 7.0 g/dl~~l~~ is considered severely anaemic. On the other hand, any non-pregnant women

Formatted: Font: 18 pt, Bold

Formatted: Centered

Formatted: Justified

Comment [M19]:

Comment [20]:

with a haemoglobin level of less than 11.0~~120~~ g/dl~~L~~ were classified as having anaemia and < 8.0 g/dl~~L~~ was classified as having severe anaemia.[35]

Mean corpuscular volume: [36]It represents the mean or average volume of a single red cell and is a ~~useful~~ valuable index used in the classification of anaemias. It is expressed in femtoliters (fl~~Fl~~).

MCV = Volume of packed cell (L/L) x 1000

RBC count (x 1012/L)

With a normal pregnancy, blood volume increases, which results in a concomitant haemodilution. Although red blood cell (RBC) mass increases during pregnancy, plasma volume increases more, resulting in ~~a~~ relative anaemia. This results in a physiologically lowered haemoglobin (Hb) level, haematocrit (Hct) value, and RBC count, but it ~~has no effect on~~does not affect the mean corpuscular volume (MCV).

In an iron-replete population, anaemia defined as a value less than the fifth percentile is a haemoglobin level of 11 g/dL or less in the first trimester, 10. 5 g/dL or less in the second trimester, and 11 g/dL or less in the third trimester.[37]

Decreased MCV: Microcytic anaemias are caused by insufficient haemoglobin synthesis, resulting in hypochromic cells. Microcytosis is caused by iron deficiency or the inability to ~~utilize~~ utilise iron, which occurs in anaemia of chronic disease. [38]

Increased MCV: Drugs that interfere with erythropoiesis are the common causes of macrocytosis. Other common causes include anaemias due to folate and vitamin B12 deficiency. They may be ~~recognized~~ recognised by other alterations in the peripheral smear.

MCHC: It is calculated from the amount of haemoglobin per decilitre and represents the average concentration of haemoglobin in the individual red cell. It is expressed in percentage.

~~Haemoglobin (g/dl)~~

Formatted: Font: 18 pt, Bold

Comment [M21]:

Formatted: Justified

Formatted: Justified

Formatted: Justified

MCHC= Haemoglobin (g/dl)

Packed red cell volume (L/L)

The average value is 35%. MCHC levels are affected by conditions that affect either haemoglobin or haematocrit determination.

MCH: Mean corpuscular haemoglobin is expressed in picogram~~pg~~. (pg ~~picogram~~) and represents the average quantity (wt.) of haemoglobin per individual red cell. It can be calculated manually or by automated methods using the following formula.

Haemoglobin (g/dl)

MCH = Red cell count (X1012/L)

The normal range of MCH is 27 to 32 pg. In anaemia, haemoglobin mass per red cell is decreased~~,~~ as haemoglobin synthesis is impaired, leading to a decrease in MCH. The decline in MCH parallels the MCV closely.

RDW: Red cell distribution width is equivalent ~~of~~ to anisocytosis in the analysis of peripheral smear and is a measure of the heterogenicity of distribution of red cell size. The RDW, which is derived from the red cell histogram, is an index of the variation of the size of red cells and can be used to detect anisocytosis.

RDW = SDx100

MCV

The earliest hematologic manifestation of iron deficiency is elevated RDW. RDW is more sensitive in screening for iron deficiency, in that it may become abnormal even before MCV falls below the lower limits of normal.

Red cell morphology: red cell morphology is the most useful procedure in the initial evaluation of a patient with anaemia. The stained blood film is first examined under low power then examined under 40x magnification and then under 100x magnification. Cells are

Formatted: Font: 18 pt, Bold

Comment [M22]:

Formatted: Justified

Formatted: Indent: Left: 1"

Comment [M23]:

Formatted: Justified

Formatted: Indent: Left: 0.5"

Formatted: Justified

graded depending upon the size, shape abnormalities, and variation in colour intensity of staining.[39]

Reticulocyte count: Reticulocytes are immature red blood cells containing residual ribosomal RNA(ribonucleic acid)~~contain remnants of ribosomal ribonucleic acid (RNA) that is present in the cytoplasm of the nucleated precursors in large amounts~~. Ribosomes form blue or purple precipitates of granules or filaments, when they react with certain basic dyes such as Brilliant cresyol blue or new methylene blue.[40] The reticulocyte count provides an initial assessment of whether the cause of anaemia is due to impaired RBC production or due to increased loss in the peripheral circulation (e.g., blood loss, haemolysis). The normal reticulocyte count by light microscopy is 0.5 to 2.5% of the total red cells. Flow cytometry based automated methods are being widely used nowadays. The automated methods exhibit a greater degree of reproducibility as they count a large number of cells. In the presence of anaemia, the reticulocyte count must be corrected because it is spuriously elevated in anaemia due to reduced RBC count. The easiest way to adjust the reticulocyte count to the degree of anaemia is the absolute reticulocyte count.

Absolute reticulocyte count = % reticulocytes × RBC count/L. 4

~~(Normal values for the absolute reticulocyte - 25 to 75 × 109 /L)~~

Haemoglobin electrophoresis: Electrophoresis is the movement of charged molecules in an electric field. Normal reference values can vary by laboratory, but are generally within the following ranges. [40],[41],[42].

Adults

- Hb A1:95-98%
- Hb A2:2-3%
- Hb F:0.8-2.0%
- Hb S:0%
- Hb C:0%.

Formatted: Font: 18 pt, Bold

Comment [M24]:

Comment [M25]: 4??

Comment [M26]: ?

Normal red cell values:

Red cell count [42],[43]

~~Birth: 6.0 +/- 1.0x1012/L~~

Men: 5.0 +/- 0.5x1012/L

Women: 4.5 +/- 0.5x1012/L

Haemoglobin:

~~Birth: 18.0 +/- 4.0gm/dl~~

Men: 15.0 +/- 2.0 gm/dl

Women: 13.5 +/- 1.5gm/dl

Packed cell volume:

~~Birth: 0.60 +/- 0.15 l/l~~

Men: 0.45 +/- 0.05 l/l

Women: 0.41 +/- 0.05 l/l

MCV:

~~Birth: 110 +/- 10 Fl~~

Adults: 92 +/- 9 Fl

MCH:

~~Birth: 34 +/- 3 pg.~~

Adults: 29.5 +/- 2.5 pg.

MCHC:

~~Birth: 33 +/- 3 gm/dl~~

Adults: 33 +/- 1.5 gm/dl

Formatted: Font: 18 pt, Bold

Formatted: Centered

Comment [M27]: Check all normal values with standard book. dacie or wintrobe as reference

Formatted: Indent: Left: 0", Line spacing: Multiple 1.08 li

Reticulocyte count:

Adults and children: 0.2 – 2 %

IRON DEFICIENCY ANEMIA:

Iron deficiency anaemia is the end stage of a relatively long drawn process of deterioration in the iron status of the individual. It represents a very small proportion of iron deficiency state.[44] Pregnancy is associated with increased iron demand~~,~~ and, therefore, increases the risk of iron deficiency anaemia. Up to 52% of pregnant women in the developing world are affected. Pregnancy and lactation result in increased iron demands.

Pre-latent iron deficiency (Storage iron depletion):

Iron reserve is reduced or absent in this stage. The abnormalities include, decreased iron stores and increased iron absorption from the gastro-intestinal tract. The pre-latent phase of iron deficiency is ~~characterized~~ characterised by reduced serum ferritin, and reduced iron concentration in the marrow and liver tissue. Haemoglobin, serum iron, total iron binding capacity and transferrin saturation are within normal limits.[45]

Latent iron deficiency (Iron limited erythropoiesis):

Latent iron deficiency state develops when iron stores are exhausted. In addition to the already reduced iron stores, serum iron and transferrin saturation are also low, and are associated with increased total iron binding capacity and increased free erythrocyte protoporphyrin. However, haemoglobin levels are still within normal limits.[45]

Iron deficiency anaemia:

As the negative iron balance continues, the production of erythroid cells in the marrow is impaired leading to the reduction in haemoglobin concentration with the development of progressive microcytic~~,~~ hypochromic anaemia. Thus, Hb%, MCV, MCH and MCHC are

Formatted: Font: 18 pt, Bold

Formatted: Right

Formatted: Justified

reduced, along with decreased serum iron, increased TIBC, and decreased transferrin saturation. Transferrin saturation below 12 - 16 % is diagnostic of iron deficiency state.[45]

Iron deficiency results when an insufficient amount of iron is available to meet the requirements of the body.[46]

It occurs because of:

1. A. Iron loss
2. B. Inadequate dietary iron intake
3. C. Impaired iron absorption
4. D. Decreased total body iron
5. E. Increased iron requirement.

Laboratory findings

The MCV and MCH values are reduced in most of the patients, and the MCHC is reduced in long-standing or severe disease. The degree of change in the red cell indices is related to the duration and to the severity of the anaemia.

Biochemical parameters based on iron metabolism are often used to diagnose and define iron deficiency.[47],[48]

Serum ferritin:

Serum ferritin concentration is directly related to macrophage iron stores. A value less than 12 µgm/L indicates absent iron stores. Serum iron is reduced to 10 – 15 µg/dl in IDA, but it is also affected by diurnal variation and dietary intake.

TIBC (Total iron binding capacity): Normal range is 200 – 450 µg/ml. In IDA, TIBC is increased to 350 – 450 µg/dl. In anaemia of chronic disease, serum ferritin and TIBC are reduced, and it is the TIBC which distinguishes it from IDA.

Transferrin saturation: Serum iron concentration is divided by TIBC to calculate transferrin saturation, which is a measure of the occupied binding site of transferrin. A value of less than 16 % (normal 30 – 40 %) is diagnostic of IDA.

Formatted: Font: 18 pt, Bold

Formatted: Font: 12 pt

Formatted: List Paragraph, Numbered + Level: 2 + Numbering Style: 1, 2, 3, … + Start at: 1 + Alignment: Left + Aligned at: 0.25" + Indent at: 0.5"

Formatted: Justified

Formatted: Font: 18 pt, Bold

These biochemical tests may be altered by physiological states unrelated to iron stores such as acute and chronic inflammation, metastatic tumours and liver disorders.

Reticulocyte haemoglobin:

It is a useful parameter for the diagnosis of IDA. The amount of reticulated Hb is an early and sensitive indicator of iron deficiency.

ANEMIA IN MALARIA[49].

Malaria is one of the leading causes of morbidity in the tropics. Pregnant women continue to constitute one of the most important risk groups. The World Health Organization estimates 300 to 500 million malaria cases annually, with 90% of this burden ~~being~~ in Africa. The estimated annual mortality attributed to malaria ranges from 700,000 ~~to2~~to 2.7 million cases globally and more than 75% of them are African children and expectant mothers. 2.5 million cases out of the global burden of malaria are contributed by Southeast Asia. Out of this, 76% of the total cases ~~is~~ are contributed by India alone.

Malaria is caused by protozoan parasites of the genus Plasmodium (P), of which four species infect man. The most serious infections are caused by P. falciparum, which causes cerebral malaria, anaemia, and renal failure. The other species which infect man are P. vivax, P. malariae, and P. ovale. The parasites are transmitted by mosquitoes of the genus Anopheles. During its life cycle, the malaria parasite passes through a number of distinct changes in its human and mosquito hosts.[50]

Despite a great deal of work, the pathogenesis of ~~the~~ anaemia in malaria remains uncertain.

1. H~~h~~aemolysis of ~~parasitized~~ parasitised red cells

haemolysis occurs when the trophozoites mature into schizonts and release merozoites into the blood stream after the red cells burst, infect fresh red cells.

2. H~~h~~aemolysis of non-~~parasitized~~ parasitised red cells

Immune hemolysis due to the adherence of the circulating antigen- antibody complexes to the surface of the erythrocytes.

3. Dyserythropoiesis

Impairment of bone marrow function due to hypocellularity and decreased iron incorporation are seen in some cases.

Laboratory findings:[51]

Normocytic normochromic anaemia is seen in the peripheral blood picture. The white cell count is usually normal, but may be raised in severe malaria. Very occasionally, there is a leucoerythroblastic picture. Mild monocytosis can be seen. The cells are frequently vacuolated and show erythrophagocytosis of malarial pigments. There is initial eosinopenia with reactive eosinophilia in the weeks following the acute infections. In acute malaria, there is neutropenia due to the margination of the neutrophils at the endothelial surfaces in the circulation. Numerous transformed lymphocytes or plasmacytoid cells with dark blue cytoplasm, large nuclei and prominent nucleoli are seen. The platelet count is reduced. Hemoparasites are seen in the form of trophozoites, schizonts or gametocytes. The fibrinogen levels are usually elevated. The fibrin degradation products are elevated. Antithrombin levels are reduced in proportion to the severity of parasitemia. Prothrombin time may be prolonged. Acute phase proteins, C-reactive protein, fibrinogen, immunoglobin, and cytokine levels are raised.

ANEMIA DUE TO INFECTIONS [52]

Bacterial sepsis due to H. influenzae, Staphylococci and Streptococci may be complicated by direct hemolysis of RBCs.

ANEMIA IN CHRONIC DISEASES [53]

Formatted: Font: 18 pt, Bold

Formatted: Justified

The anaemia that is observed in patients with infections, inflammatory, or neoplastic diseases that persist for more than one or two months is called anaemia of chronic disease. The characteristic feature of this syndrome is the occurrence of hypoferritinemia in the presence of ample reticuloendothelial iron stores.

Chronic diseases associated with anaemia:

1. ~~1.~~ Chronic infections e.g.: Tuberculosis, Empyema, Pyelonephritis, Osteomyelitis
2. ~~2.~~ Chronic inflammatory disorders e.g.: Inflammatory bowel disease, Rheumatoid arthritis
3. ~~3.~~ Malignant diseases e.g.: Lymphoma, C~~c~~arcinoma

Laboratory findings: RBCs are usually of the normocytic and normochromic ~~microcytic hypochromic~~ variety. The Reticulocyte count is reduced. The bone marrow is normo or hypocellular. Serum ferritin levels are normal or increased. TIBC is low or normal. Erythropoietin production is reduced and there is defective ~~mobilization~~ mobilisation of iron storage sites to the marrow.

ANEMIA OF RENAL INSUFFICIENCY

Anaemia is an almost invariable manifestation of chronic renal failure, often contributing substantially to the morbidity of the condition. The term anaemia of chronic renal insufficiency refers to anaemia resulting directly from the failure of the endocrine functions and the filtering functions of the kidney. The ~~major~~ primary source of erythropoietin is ~~kidney, and the ability to produce this hormone is lost~~the kidney, which loses the ability to produce this hormone as the kidney fails.

The pathogenetic mechanisms are:

1. ~~1.~~ Decreased production of erythropoietin (EPO)
2. ~~2.~~ Impaired response to erythropoietin.
3. ~~3.~~ haemolysis due to uremic plasma resulting in deformed RBCs.
3.

Formatted: Font: 18 pt, Bold

Formatted: Numbered + Level: 1 + Numbering Style: 1, 2, 3, … + Start at: 1 + Alignment: Left + Aligned at: 0.25" + Indent at: 0.5"

Formatted: Justified

Formatted: Justified

Formatted: Font: 12 pt

Formatted: List Paragraph, Numbered + Level: 1 + Numbering Style: 1, 2, 3, … + Start at: 1 + Alignment: Left + Aligned at: 0.25" + Indent at: 0.5"

Laboratory findings:

The anaemia is normocytic or microcytic but slight macrocytosis is observed occasionally. The reticulocyte count is decreased or within normal limits. The anaemia tends to become more severe as renal failure worsens. Majority of the red cells appear normal on blood smears. Occasionally, ~~however,~~ "burr cells" are observed along with some triangular, helmet-shaped, or fragmented cells.

Formatted: Font: 18 pt, Bold

Formatted: Justified

Formatted: Left

Formatted: Left, Indent: Left: 0"

METHODOLOGY

The present study is a cross sectional, descriptive study conducted on 130 reproductive age women in the age group of 15 years to 49 years, in IPD and OPD departments of Santosh Hospital, Ghaziabad with anaemia and those who presented with other complaints and were incidentally found to have anaemia. ~~The w~~Women with haemoglobin values of less than 11 gm/dl in the age group of 15 years to 49 years were included in the study which was conducted from December 2020 to October~~November~~ 2021.

METHOD OF STUDY

A detailed history was taken, a thorough clinical examination was performed and the data recorded in the proforma. The required quantity of venous blood was collected in EDTA tubes.

The collected blood was ~~analyzed~~ analysed using Sysmex XN-350 auto ~~analyzer~~analyser, having five-part differentials, from which the following parameters were obtained.

- Hb%
- PCV
- RBC count
- RBC indices including MCV, MCH, MCHC
- Platelet count
- Total WBC count

Peripheral smears were prepared on glass slides and stained with Leishman's stain. The reticulocyte count was done by the supravital staining technique using brilliant cresyel blue. Among the microcytic hypochromic anaemia cases, iron deficiency anaemia was diagnosed by serum ferritin estimation. Among the macrocytic anaemias, suspected cases were further evaluated by vitamin b12 levels. The hemolytic anaemia cases which were suspected on clinical and peripheral blood examination, were taken up for a complete hematological work up including Hb electrophoresis, on the specific requirement. Other ancillary tests including stool examination, urine examination, liver function tests, renal function tests, Mantoux test, radiological investigations like x ray were done whenever required.

Formatted: Font: 18 pt, Bold

Formatted: Left, Indent: Left: 0"

Formatted: Justified

Formatted: Justified

Formatted: Justified

Sysmex XN-350 [54] used in the present study is an automated cell counter with five-part differentials. The blood cell counting is based on the impedance principle with both the cell counts and histograms obtained through the analysis of blood cell dilution. It has three detector blocks and two kinds of reagents for blood analysis. The WBC detector measures WBC count, using DC detection method. The RBC and platelet counts are measured by RBC detector blocks which also employ the DC detection method. The HGB detector block measures the haemoglobin concentration by using the non-cyanide method.

Peripheral smear examination [55] Ideal, tongue shaped peripheral smears were prepared on clean glass slides and stained with Leishman's stain using the following standard procedure. Leishman's stain, was prepared in a conical flask to which, 0.2 gm of powdered dye was added to 100 ml of methanol. This mixture was warmed to 50°C for 15 minutes with intermittent shaking, allowed to cool and then filtered.

~~**Sysmex XN 350 auto analyser**~~

Formatted: Font: 18 pt, Bold

Formatted: Superscript

Formatted: Font: (Default) +Headings CS (Times New Roman), Bold

Formatted: Font: (Default) +Headings CS (Times New Roman), No underline

Formatted: Font: (Default) +Headings CS (Times New Roman), No underline, English (U.S.)

Figure 2: Sysmex XN 350 Auto analyzer.

Formatted: Font: 18 pt, Bold

Comment [M28]: Needs formatting . also check normal values from reference book. Keep units same throughout

Formatted: Character scale: 99%

Formatted: Font: 10 pt, Not Bold

Formatted: Justified, Line spacing: 1.5 lines

Figure 1. Sysmex XN 350 auto analyser

Formatted: Font: 18 pt, Bold

Formatted: Font: (Default) +Body (Calibri), 14 pt, Bold, Underline, Character scale: 99%

Formatted: Font: 12 pt

Formatted: Font: Arial Black, 12 pt, Bold, Underline, French (France)

Formatted: Left, Indent: Left: 0", Right: 0", Space Before: 0 pt, Line spacing: Multiple 1.08 li

Formatted: French (France)

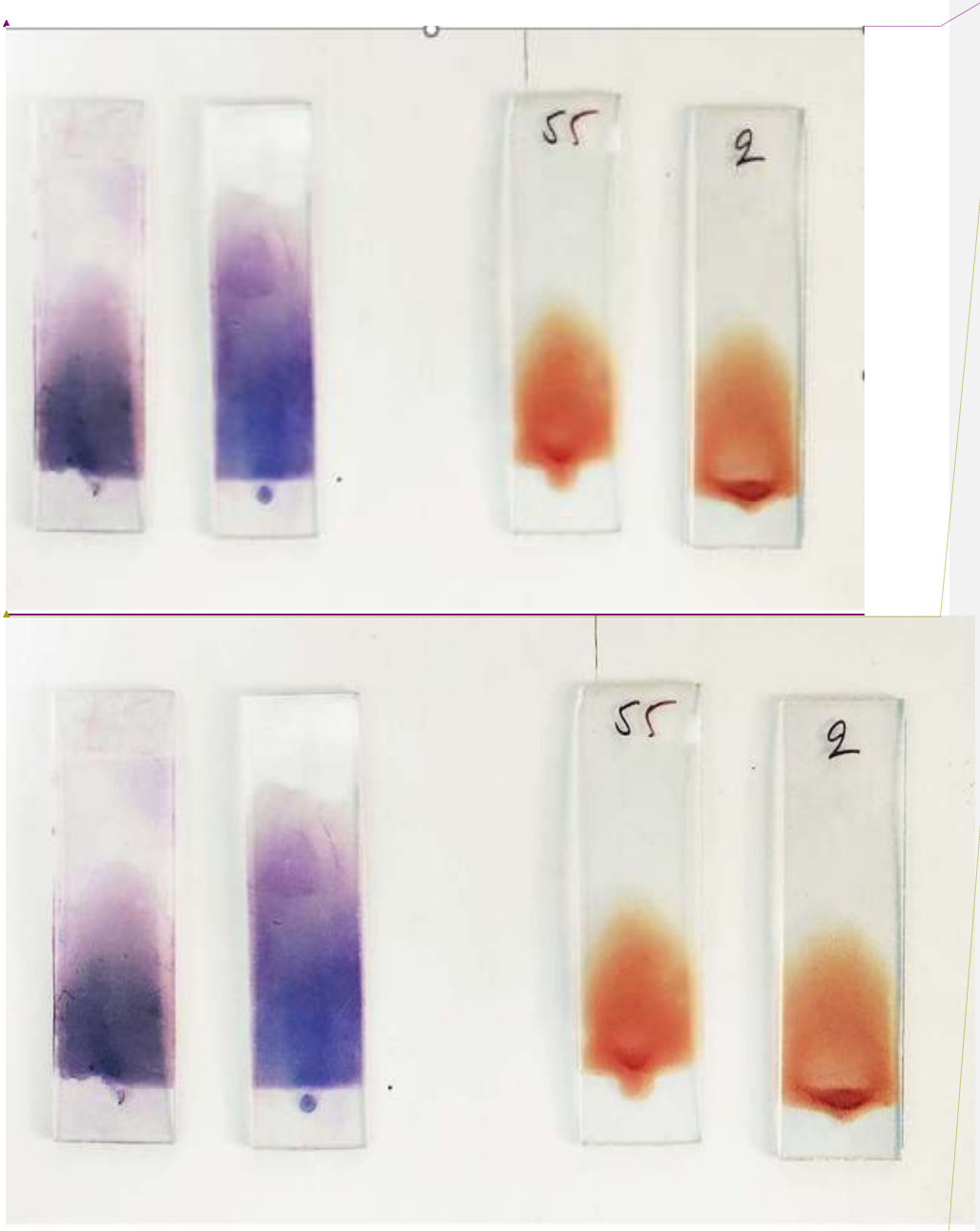


Figure 3: Ideal tongue shaped Leishman-stained smears and unstained smears.

Figure 2.

Formatted: Font: 18 pt, Bold

Formatted: Font: (Default) Times New Roman, 14 pt, Bold, Underline, Character scale: 99%

Formatted: Font: (Default) Times New Roman, 10 pt, Character scale: 99%

Formatted: Font: (Default) +Headings CS (Times New Roman), 12 pt, No underline

Ideal tongue shaped Leishman-stained smears and unstained smears.

Staining technique[55]**:** The air-dried film was flooded with the stain for 2 to 4 minutes, following which, double the volume of distilled water was added to dilute the stain and left for 5 to 7 minutes. It was then washed in a stream of water. The back of the slide was wiped

Formatted: Font: 18 pt, Bold

Formatted: Font: (Default) +Headings CS (Times New Roman), 12 pt, Bold

Formatted: Left, Indent: Left: 0", Right: 0", Space Before: 0 pt, Line spacing: Multiple 1.08 li

Formatted: Font: 16 pt, Bold

Formatted: Justified

and the slide was set upright to dry. Stained slides were examined by a light microscope under the oil immersion objective (100X) at the junction of the body and the tail of the smear, since the red cells were evenly distributed and were not distorted in this area. Relevant observations were made depending on the following criteria:

Size of RBCs [55]: On microscopy, a normal sized red cell is comparable to the size of the nucleus of a small lymphocyte. Normally, red cells exhibit narrow variations in size as reflected by normal red cell distribution width (RDW) of 11-15%. A wide variation in cell size is described as anisocytosis. Abnormalities of cell size can be microcyte (smaller) or macrocyte (larger RBC). Anisocytosis correlates with mean cell volume (MCV) except in combined deficiency states. The normal MCV range is 8076–10096 femtoliters. MCV above 10096fl suggests macro-cytosis. Macrocytes may be oval (ovoid) or round shape and this has diagnostic implications. Oval macrocytosis is associated with megaloblastic anaemias (folate or cobalamin deficiency), myelodysplasia and use of drugs like hydroxycarbamide. Round macrocytes are seen in liver disease and alcoholism.

Shape of RBCs: The normal red cell is biconcave disc-shaped, measures about 7–8 µm in diameter, has central pallor ~~(approximately a third of the red cell diameter)~~ and lacks intra-cytoplasmic inclusions. Variations in the shape of RBCs is called poikilocytosis. Some extent of poikilocytosis may be seen in normal blood smears. Poikilocytosis are produced in conditions associated with abnormal erythropoiesis and in congenital hemolytic anemias. The various types of poikilocytes are:

Irreversibly sickled red cells (drepanocytes): Sickle cell syndromes (SS, SC, Sβ thalassemia).

Target cells (codocytes, Mexican hat cells): Sickle cell disease, hemoglobin C trait, hemoglobin C~~C~~ disease, thalassemia, iron deficiency, l~~L~~iver disease (cholestasis), asplenia

Fragmented red cells (schistocytes, helmet cells, keratocytes): Thrombotic microangiopathic hemolytic anemias such as Disseminated intravascular coagulopathy (DIC), thrombotic thrombocytopenic purpura, hemolytic uremic syndrome.

Burr cells (echinocytes, crenated red cells): In-vitro artifact following prolonged storage or slow drying of the smear due to high humidity, uremia~~,~~.

Spur cells (acanthocytes): Liver disease, Renal failure, Abetalipoproteinemia, Spur cell anaemia, pyruvate kinase deficiency.

Tear drop cells (dacrocytes): Myelofibrosis, Myelophthisia (marrow infiltrations), Extramedullary hemopoiesis, Hereditary elliptocytosis, Hereditary pyro poikilocytosis, Severe iron deficiency, Megaloblastic anaemia, Thalassemia, Myelodysplastic syndrome.

Bite cells (degmacytes): G6PD deficiency, Oxidative stress, unstable haemoglobins, congenital Heinz body anaemia.

Pencil cells: Iron deficiency

Stomatocytes: Artifact (due to slow drying in a humid environment), Liver disease, alcoholism, Rh-null disease, Obstructive lung disease.

Elliptocytes: Hereditary Elliptocytosis (>25%) Basket cells (half ghost cells/Blister cells).

Spherocytes: Oxidant damage, G6PD deficiency, Unstable haemoglobin, Hereditary spherocytosis, ABO incompatibility, Autoimmune hemolytic anaemia (warm antibody type), Severe burns.[55]

Staining characteristics of RBCs: The colour of the red cells is reflected by ~~its~~ their haemoglobin content. Increased hemoglobinization is termed hyperchromia. Decreased hemoglobination is hypochromia. Hyperchromic cells lack central pallor and can occur in the setting of large cell such as polychromatic cells, small cells such as microspherocytes or an abnormally shaped cell. Shape abnormalities associated with hyperchromia include irreversible sickled red cells, spherocytes and irregularly contracted cells (ICC or pyknocytes). Spherocytes are seen in hereditary spherocytosis. Small cells termed micro-spherocytes (densely hemoglobinized) occur in immune hemolytic anaemia (splenic macrophages bite off portions of the membrane with the bound antibody and the cell reseals with a smaller volume); burns and, less frequently micro-angiopathy. Irregularly contracted cells~~CC~~ lacks central pallor with irregular~~ly~~ (non- uniform) margins and is seen in haemoglobin sickle cell ~~SC~~, haemoglobin c~~CC~~ disease, oxidant injury and unstable haemoglobinopathy. Crenated red cells may be artefactual due to crenation of red cells in stored blood following delayed analysis. Hypochromia reflects low haemoglobin content in the red cell and commonly results from iron deficiency. Severely hypochromic and large cells with thin borders are termed leptocytes and may also be seen in liver diseases.

Furthermore, the arrangement of the cell may generate some clinical suspicion. Rouleaux formation (stacking of the red cells like coins) in the presence of a bluish background

Formatted: Font: 18 pt, Bold

Formatted: Font: Bold, Underline

suggests paraproteinemia / plasma cell dyscrasia. Rouleaux ~~are~~ is also seen in macroglobulinemias. Agglutination of the red cells may be seen in cold haemagglutinin disease (CHAD) and Waldenstroms macroglobulinemia while erythro- phagocytosis is seen in paroxysmal cold hemoglobinuria.

Total leukocyte count and Differential count: The total leukocyte count and Differential counts were estimated by Sysmex XN - 350 cell counter in the present study. Blood smears stained with Leishman's stain were examined under oil immersion objective for the morphological details of white blood cells.

Platelet count: Platelets are elliptical to circular bodies with basophilic cytoplasm and azurophilic granules. There is approximately one platelet for every twenty RBCs in normal conditions. Presence of one or two platelet aggregates in each high-power field in the peripheral smear indicates adequate platelet count. Quantitative estimation of platelets was done manually by Neubauer's counting chamber and mechanically by Sysmex XN -350 cell counter.

Reticulocyte count: Reticulocytes are the young RBCs which are stained by supravital staining. They appear slightly larger in diameter than mature red cells and contain delicate basophilic cytoplasmic network. An increase in reticulocyte count indicates hyperactivity of bone marrow and a reduction in the count indicates poor production of red cells. Reticulocyte count is a percentage count and its significance changes with the RBC count. Hence, absolute reticulocyte count is considered more reliable.

Supra-vital staining: 2 to 3 drops of brilliant cresy~~o~~l blue were taken in a plastic tube to which 2 to 4 times, volume of patient's EDTA anticoagulated blood was added and mixed. This mixture was incubated at 37 degree ~~o~~celsius ~~C~~ for 15 to 20 minutes. After gentle mixing, smears were made on clean glass slides. When the slides were dry, they were examined under oil immersion lens. The number of RBCs and the reticulocytes were counted in 10 to 15 fields.~~25 61~~

Calculation: Total number of RBCs counted in all the fields = Y cells

Total number of reticulocytes counted in all the fields = X cell

% Reticulocyte count = X * 100

Formatted: Font: 18 pt, Bold

Formatted: Justified

Formatted: Indent: Left: 0"

Y

Normal values – 0.5 to 2 %

Absolute reticulocyte count = % reticulocyte count x RBC count

Normal absolute reticulocyte count ranges from 40,000 to 1 lakh cells/cumm

Serum ferritin estimation [56]

Serum ferritin estimation was done by chemiluminescence immunoassay (CLIA method) when IDA was suspected. It indicates the status of the iron stores.

Normal level - 50-300 µgm/dl.

World Health Organization serum ferritin guideline of a <15 µg/L threshold for iron deficiency in healthy women.

Vitamin B12 and folic acid assay [56]

These were performed in clinically and hematologically suspected cases of megaloblastic anemias for the confirmation of diagnosis. The assay was done by chemiluminisence immuno assay (CLIA method). Normal value of vitamin B12: 200-950~~200 – 400~~ pg~~m~~/ml .

Levels lesser than 20~~10~~0 pg~~m~~/ml indicated B12 deficiency.

Normal serum folate level: 4-20 ngm/ml.

Levels lesser than 3 ngm/ml indicated folate deficiency.

Formatted: Font: 18 pt, Bold

Formatted: Indent: Left: 0", Line spacing: 1.5 lines

Formatted: Indent: Left: 0"

Formatted: Indent: Left: 0"

Formatted: Justified, Indent: Left: 0"

Formatted: Justified

Formatted: Justified, Indent: Left: 0"

Formatted: Font: Not Bold

Formatted: Justified

Formatted: Justified, Indent: Left: 0"

Formatted: Justified

Comment [M29]: Where is figure 1??? Refer all figures in text

RESULTS

The present study was carried out on 130 anaemic women of reproductive age 15-49 years who attended the IPD and OPD department of Santosh medical college hospital Ghaziabad These 130 patients were categorized as per their age. (Table 1)

Table No. 1: Distribution of anaemia among participants according to their age

Age	Number	percentage
< 20 years	19	14.6
20-30 years	54	41.5
30 -40 years	32	24.6

Formatted: Font: 18 pt, Bold

Formatted: Indent: Left: 4.93"

Formatted: Indent: Left: 2.5"

Comment [M30]:

Formatted: Indent: Left: 2.5"

Comment [M31]: You have compared only age and severity
Needs comparisons of eitiology and morphology as committed in aims and objectives

Formatted: Font: 14 pt, Font color: Text 1, English (India)

Formatted: Font: 14 pt, Font color: Text 1

Formatted: Font: Not Bold, English (India)

Formatted Table

Formatted: Font: Not Bold

Formatted: Font: Not Bold, English (India)

Formatted: Font: Not Bold

Formatted: Font: Not Bold, English (India)

Formatted: Font: Not Bold

Formatted: Font: Not Bold, English (India)

Formatted: Font: Not Bold

Formatted: Font: Not Bold, English (India)

Formatted: Font: Not Bold

Formatted: Font: Not Bold, English (India)

Formatted: Font: Not Bold

Formatted: Font: Not Bold, English (India)

Formatted: Font: Not Bold

Formatted: Font: Not Bold, English (India)

Formatted: Font: Not Bold

Formatted: Font: Not Bold, English (India)

Formatted: Font: Not Bold

Formatted: Font: Not Bold, English (India)

Formatted: Font: Not Bold

Formatted: Font: Not Bold, English (India)

Formatted: Font: Not Bold

Above ~~Above~~ 40 years	25	19.3~~2~~
Total	130	100

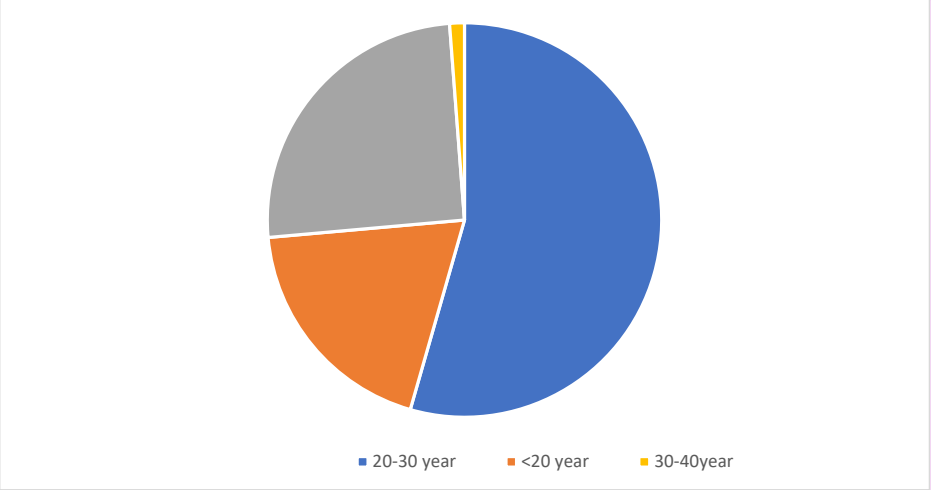


Table no 1 indicates ,~~In the present study,~~ age group of 20-30 years were found to be the most affected, thus constituting 41.5%, followed by 24.6 % of age group 30-40 years, followed by 19.3~~2~~% constituting above 40 years of age group, and only 14.6% belong to those below 20 years.

Table No.2: Distribution of anaemia according to severity among pregnant women.

Classification of anaemia		Mild	Moderate	Severe	Total
Frequencies		12	26	5	43

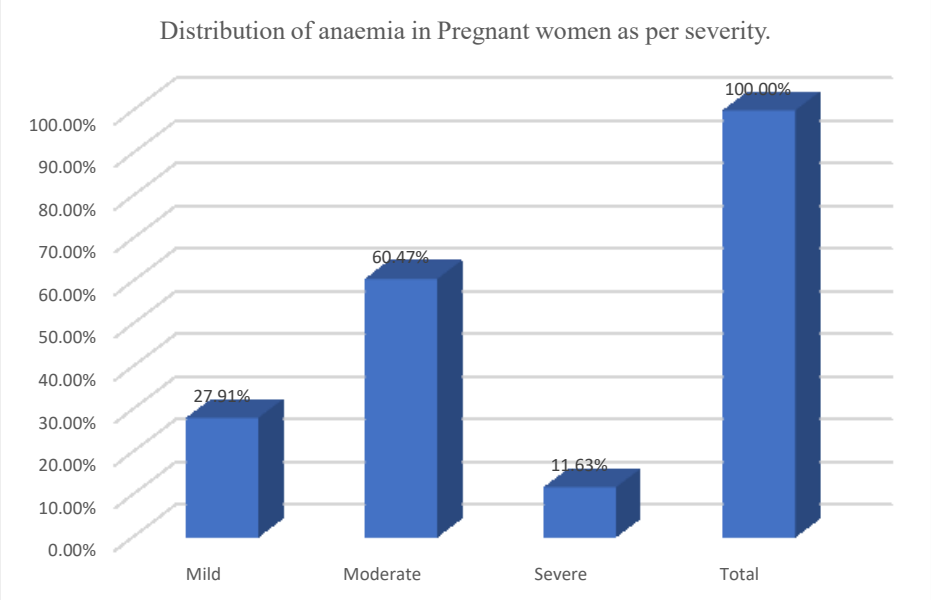
Formatted: Font: 18 pt, Bold
Formatted: Font: Not Bold, English (India)
Formatted: Font: Not Bold
Formatted: Font: Not Bold, English (India)
Formatted: Font: Not Bold
Formatted: Font: Not Bold, English (India)
Formatted: Font: Not Bold
Comment [M32]: Refer all tables and figures in text
Comment [M33]:
Formatted: Font: Not Bold, English (India)
Formatted: Font: Not Bold
Formatted: Font: Not Bold, English (India)
Formatted: Font: Not Bold
Formatted: Font: Not Bold, English (India)
Formatted: Font: 12 pt, English (India)
Formatted: Font: Not Bold
Comment [tG34]:
Formatted: Justified
Comment [M35]:
Formatted: Font: 14 pt, Font color: Text 1
Formatted: Font: (Default) Times New Roman, 14 pt, Font color: Text 1
Formatted: Font: 14 pt, Font color: Text 1
Formatted: Font: Not Bold
Formatted Table
Formatted: Font: Not Bold

Percentage	27.91%~~0~~	60.46%	11.63%~~2~~	100%~~99.98~~

~~out~~ Out of 130 women of reproductive age~~ women~~, we further classified them as per parity,43 were found to be pregnant and rest of the females were non-pregnant.

Total	Pregnant	Non pregnant
130	43	87

Out of 43 pregnant women, moderate anaemia was found in 60.46% ~~pregnant females~~, followed by mild anaemia in 27.90% and severe anaemia in 11.63% ~~pregnant women~~.(Table 2)



Formatted: Font: 18 pt, Bold

Comment [M36]: Refer in text

Formatted: Font: Not Bold

Formatted: Font: Not Bold

Formatted: Font: Not Bold

Formatted: Font: Not Bold

Formatted: Font: Not Bold

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: Not Bold

Formatted Table

Table No.3:Distribution of anaemia according to severity among non-pregnant women.

Classification of anaemia	Mild	Moderate	Severe	Total
Frequencies	1	76	10	87
Percentage	1.14	87.365	11.5049	10099.98

Out of total 87 non pregnant females, moderate anaemia was found among 87.365% of women, followed by severe anaemia in 11.5049%.

Formatted: Font: 18 pt, Bold

Formatted: Font: (Default) Times New Roman, 14 pt, Font color: Text 1

Formatted: Font: (Default) Times New Roman, 14 pt

Formatted: Font: (Default) Times New Roman, 12 pt, Not Bold

Formatted Table

Formatted: Font: (Default) Times New Roman, 12 pt, Not Bold

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt, Not Bold

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt, Not Bold

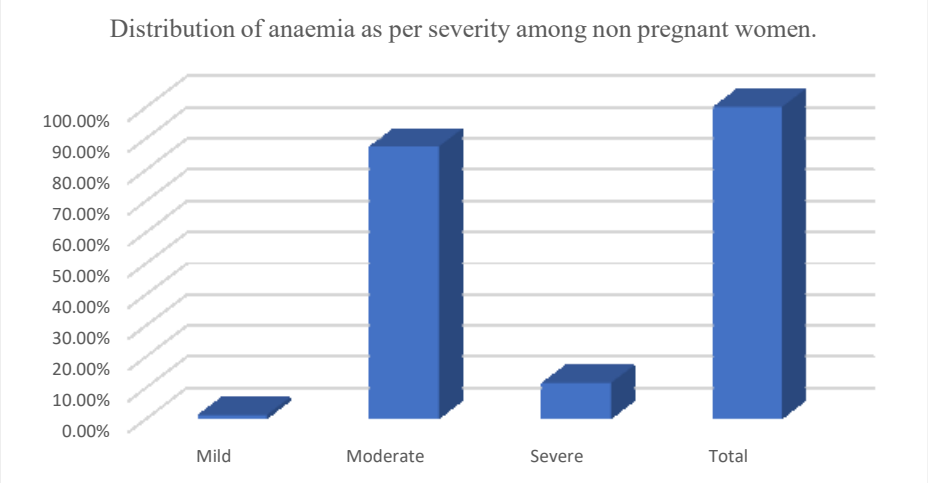
Comment [M37]: Should be 100%

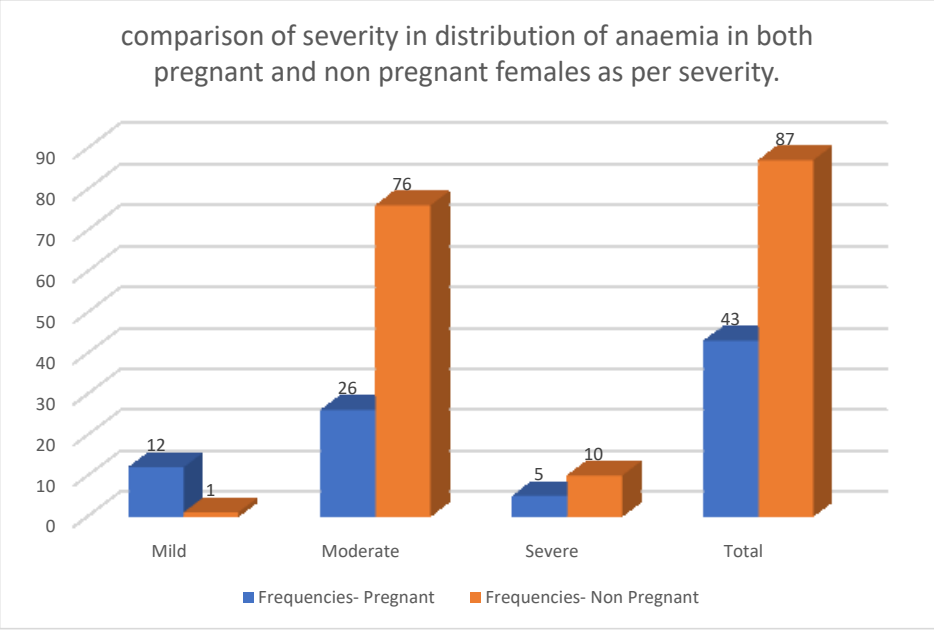
Formatted: Font: (Default) Times New Roman, 12 pt, Not Bold

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt, Not Bold

Formatted: Font: 18 pt, Bold





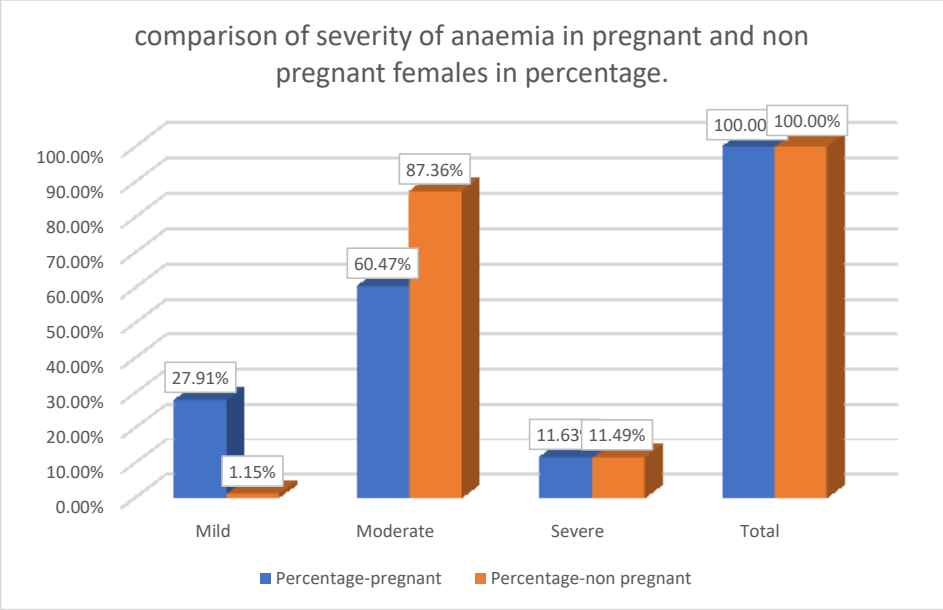


Table 4: Main~~Common~~ presenting symptoms

Ssymptoms	No.
Amenorrhea	44
Body ache, joint pain	12
polymenorrhagia	9
UTI	4
gastroenteritis	6
Generalised weakness	20
Cough	3
Abdominal pain	4

Formatted: Font: 18 pt, Bold

Comment [M38]: Should be 100%

Formatted: Font: (Default) Times New Roman, 14 pt, Font color: Text 1

Formatted: Font: (Default) Times New Roman, 14 pt, Font color: Text 1

Formatted: Font: (Default) Times New Roman, 14 pt, Font color: Text 1

Formatted: Font color: Text 1

Formatted: Font: (Default) Times New Roman, 14 pt, Font color: Text 1

Formatted: Font: 12 pt

Formatted Table

Formatted: Font: 12 pt

Formatted: Font: 12 pt

Formatted: Font: 12 pt

Formatted: Font: 12 pt

Formatted: Font: 12 pt

Formatted: Font: 12 pt

Formatted: Font: 12 pt

Formatted: Font: 12 pt

Fatigue, loss of appetite	9
Menorrhagia	6
oligomenorrhea	7
Fever	1
Non specific symptoms	5
Total	130

The above chart suggests that the most common symptom~~s~~ among our patients was amenorrhea-, 44 patients were affected. The least common symptom was fever. Out of 130 patients-, 54 of them ~~were having~~had non-specific symptoms.

Table 5: Distribution of the various morphological types of anaemia.

Morphological Type	Number	Percentage

Normocytic normochromic anaemia	20	15.4%
Microcytic normochromic anaemia	11	8.46%
Normocytic hypochromic anaemia	13	10%
Microcytic hypochromic anaemia	85	65.38%
Macrocytic hypochromic anaemia	1	0.78%

In the present study (Table 5) ,the most common morphological type of anaemia was microcytic hypochromic anaemia(65.38%) followed by normocytic normochromic anaemia(15.4%).Microcytic normochromic anaemia (8.46%), normocytic hypochromic anaemia(10%) and macrocytic hypochromic anaemia(0.78%) was the least common morphological type.

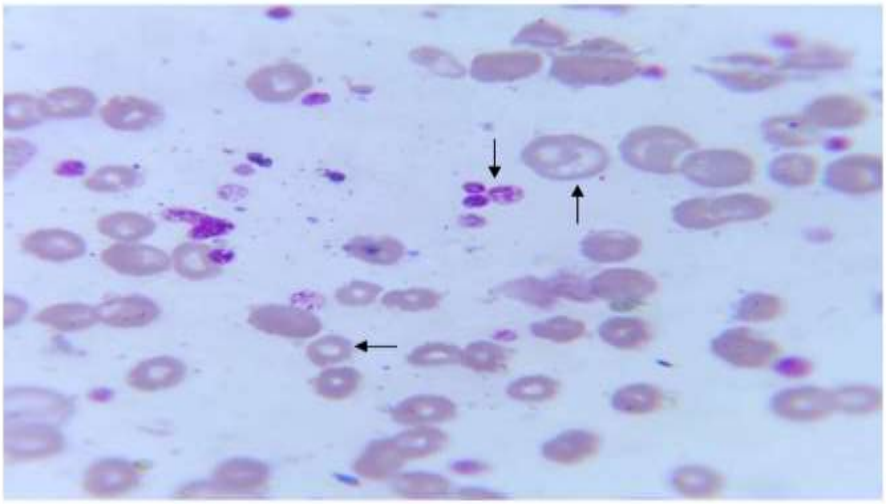


Figure 20: Dimorphic Anemia- Peripheral smear showing macrocytes and microcytic hypochromic cells and Giant platelets, Leishman's stain (x100)

Formatted: Font: 18 pt, Bold
Formatted: Font: 12 pt
Formatted: Font: 12 pt
Formatted: Font: 12 pt
Formatted: Font: 12 pt
Formatted: Font: 12 pt
Formatted: Font: 12 pt
Formatted: Font: 12 pt
Formatted: Font: 12 pt
Formatted: Font: 12 pt
Formatted: Font: 12 pt
Formatted: Justified
Formatted: Font: 12 pt
Formatted: Font: 12 pt
Formatted: Font: 12 pt
Formatted: Font: 12 pt
Comment [M39]: Keep uniformity in font size and type in legent and tables.
All tables should be uniform throughout the thesis
Formatted: Character scale: 99%

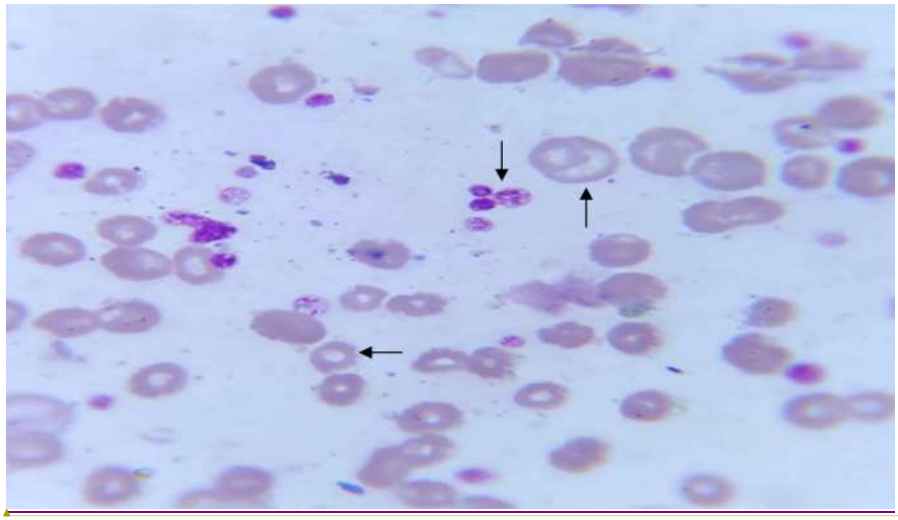


Figure 3.Peripheral smear showing macrocytes and microcytic hypochromic cells and giant platets,Leishmans stain x100.

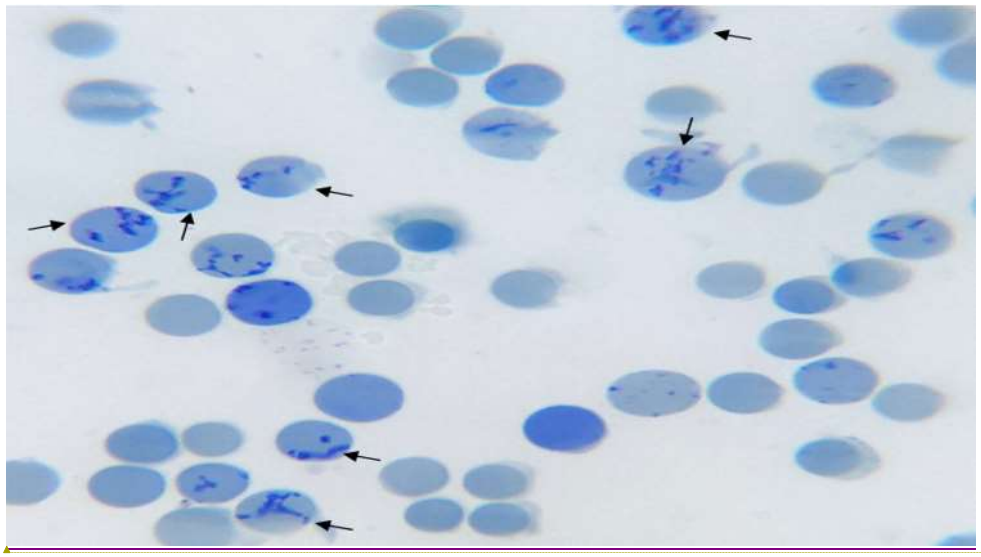


Figure 4.Haemolytic anaemia-supravital stain showing increased reticulocytes x100.

Formatted: Font: 18 pt, Bold

Formatted: Font: (Default) Times New Roman, 14 pt, Font color: Text 1

Formatted: Font: 12 pt

Formatted: Font: 12 pt, Bold

Formatted: Font: 12 pt

Formatted: Font: 12 pt, Bold

Formatted: Font: Bold

Formatted: Font: (Default) Times New Roman, 14 pt, Font color: Text 1

Formatted: Font: 12 pt

Formatted: Font: 12 pt, Bold

Formatted: Font: 12 pt

Formatted: Font: 12 pt, Bold

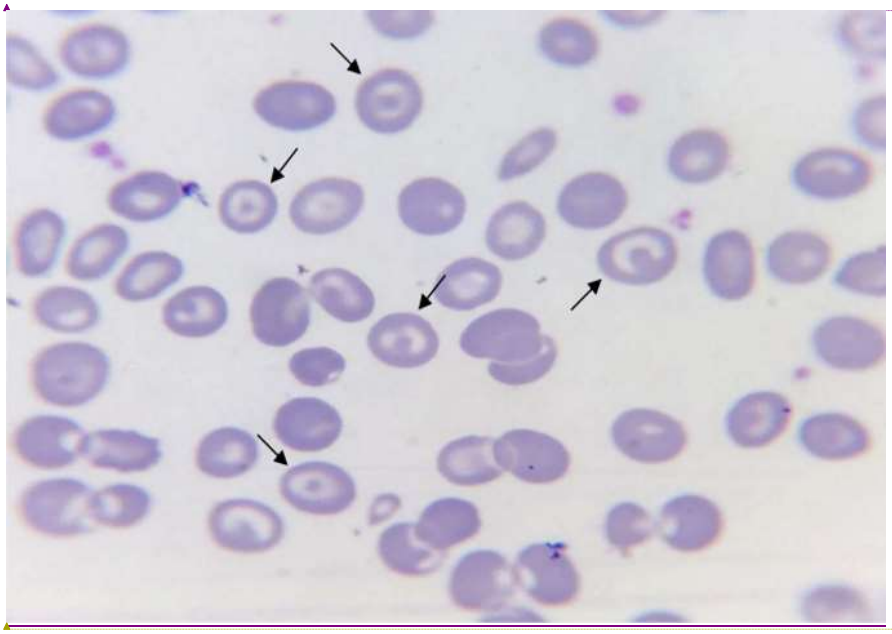


Figure 5.Haemolytic anaemia- peripheral smear showing target cells,Leishman stain x100.

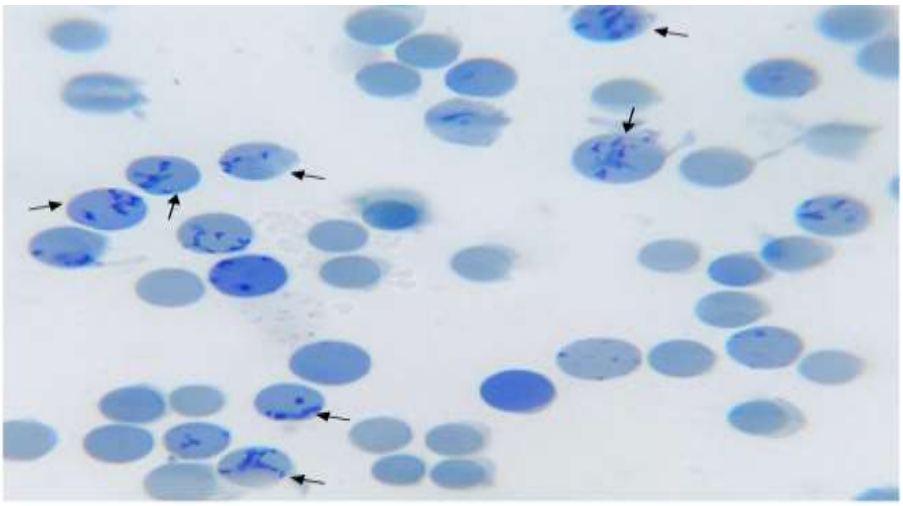


Figure 21: Hemolytic Anemia – Supravital Stain showing increased reticulocytes (X100)

Formatted: Font: 18 pt, Bold

Formatted: Font: (Default) Times New Roman, 14 pt, Font color: Text 1

Formatted: Font: 12 pt

Formatted: Font: 12 pt, Bold

Formatted: Font: 12 pt

Formatted: Font: 12 pt, Bold

Formatted: Font: Bold

Formatted: Character scale: 99%

Formatted: Font: 18 pt, Bold

Formatted: Indent: Left: 2"

D

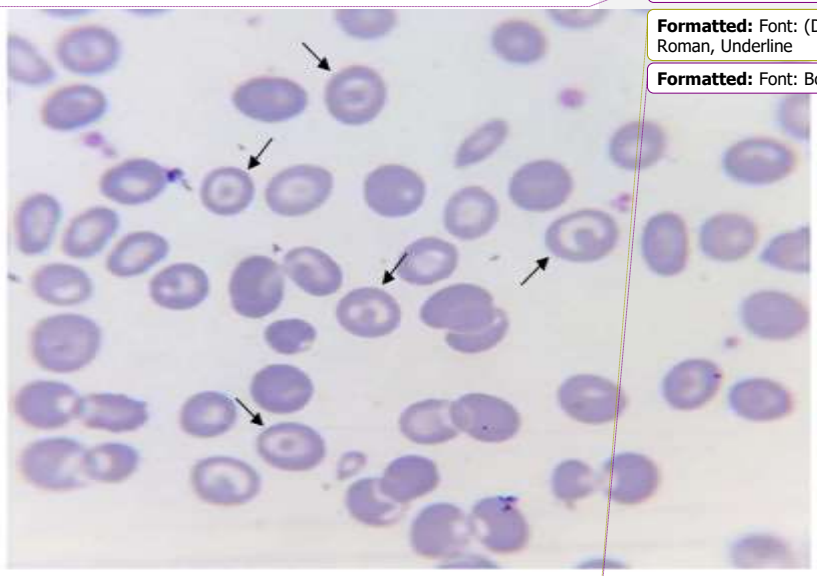


Figure 22: Hemolytic Anemia: Peripheral smear showing Target cells, Leishman stain (X100)

Formatted: Font: 18 pt, Bold

Formatted: Font: Bold, Underline

Formatted: Font: (Default) Times New Roman, Underline

Formatted: Font: Bold, Underline

Formatted: Font: (Default) Times New Roman, Bold, Underline

Formatted: Font: Bold, Underline

Formatted: Font: (Default) Times New Roman

~~D~~ISCUSSION

Anaemia is a major nutritional problem worldwide, especially in developing countries like India.[57] Anemia is the most common m~~orbidity among micronutrients and affects health, education, economy, and productivity of the entire nation~~icronutrient morbidity and affects the entire nation~~'~~'s health, education, economy, and productivity.

The most common group among the causes ~~for~~ of anaemia is malnutrition and among that group, iron deficiency makes up the bulk of it. A large portion of iron deficiency is preventable with appropriate and timely intervention. Iron deficiency is the most common nutritional disorder in the world. The numbers are staggering: two billion people – over 30% of the world~~'~~'s population – are anaemic, mainly due to iron deficiency; and in developing countries, this figure is frequently exacerbated by malaria and worm infections.[58]

Table ~~6~~15: Comparative study of severity of anemias among pregnant females.

Severity	Present study	Asma Nigar e~~E~~t al. [59]	Mishra S,Gupta P et al~~Lucknow~~[60]	Bhargavi et al. [61]
Mild	27.90%	10%	43.6%	52.73%
Moderate	60.46%	44%	47.6%	40.97%
Severe	11.62%	2.8%	8.8%	6.28%

Formatted: Font: 18 pt, Bold

Formatted: Indent: Left: 2", Right: 0", Space Before: 0 pt, Line spacing: Multiple 1.08 li

Formatted: Justified

Comment [M40]: Disparity in figure numbers. Check and correct
Keep the size and legent of all pictures uniform throughout
You can keep 2 figures on 1 page

Comment [M41]: Disparity in table numbers. Please check and correct

Comment [M43]: Author name??

Formatted: Font: 12 pt

Formatted: Font: 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: 12 pt

Formatted Table

Comment [M42]: Also write few lines about comparisons in text

Formatted: Font: 12 pt

Formatted: Font: 12 pt

Formatted: Font: 12 pt

Formatted: Font: 12 pt

Formatted: Font: 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: 12 pt

Formatted: Font: 12 pt

Formatted: Font: 12 pt

Formatted: Font: 12 pt

Formatted: Font: 12 pt

Formatted: Font: 12 pt

In present study of severity of anaemia among pregnant females, moderate anaemia was present in highest number which is in concurrence with study done by Asma Nigar et al and Mishra S et al .where as in study done by Bhargavi et al, moderate anaemia was not present in highest percentage among pregnant females.

Worldwide, anaemia affects an estimated 29% of non-pregnant women of reproductive age (Stevens et al., 2013) and is thought to contribute to 115, 000 maternal deaths annually ~~.(Ezzati, Lopez, Rodgers, & Murray, 2004).~~

Table 7~~15~~: Comparative study of severity of anemias among non-pregnant females.

Severity	Present study	SM Ziauddin H et al [62]	Rp Bichha, KP Parajuli et al [63]
Mild	1.14%	52%	632.7%
Moderate	87.365%	20%	35.33%
Severe	11.5049%	1%	1%

In the present study,mild anaemia was present in only 1.14% of non pregnant females where as in studies conducted by SM Ziauddin et al,RP Bichha et al severe anaemia was noted in

Formatted: Font: 18 pt, Bold
Formatted: Font: 12 pt, Not Bold
Formatted: Font: 12 pt
Formatted: Font: 12 pt
Formatted: Justified
Formatted: Font: 12 pt
Formatted: Font: 12 pt
Formatted: Font: 12 pt
Formatted: Font: 12 pt, Not Bold
Field Code Changed
Comment [M44]: Check spelling
Field Code Changed
Formatted: Font: 12 pt
Comment [M45]: You have changed the refencing style.. use Vancouver format
Formatted: Font: 12 pt
Formatted: Font: 12 pt, Not Bold
Formatted: Font: 12 pt, Not Bold, Danish
Formatted: Font: 12 pt, Not Bold
Formatted: Font: 12 pt, Not Bold
Formatted: Font: 12 pt, Not Bold
Formatted: Font: 12 pt, Not Bold
Formatted: Font: 12 pt, Not Bold
Formatted: Font: 12 pt, Not Bold
Formatted: Font: 12 pt, Not Bold
Formatted: Font: Not Bold
Formatted: Font: 12 pt, Not Bold
Formatted: Justified
Formatted: Font: 12 pt

lowest percentage. In present study moderate anaemia was noted in highest percentage where as in all other three comparative studies mild anaemia was noted in high percentage.

Formatted: Font: 18 pt, Bold

Formatted: Font: 12 pt

Formatted: Font: 12 pt, Not Bold

Comment [M46]: Also write few lines about comparisons in text. Whether comparable or there are differences. Reasons for the same. How do you justify and conclude your findings..

Conclusion

Formatted: Font: 16 pt

Formatted: Indent: Left: 0"

The improvement in the primary health is the most important area for scope for the prevention of nutritional deficiency anaemia because it has been associated with morbidity and mortality of women and children.Women specially child bearing age are affected with nutritional deficiency resulting in early miscarriage or delay in the development of pscychomotor activity.We need to take strong steps to educate masses and improve their living standards, so that we will be able to take effective measures to prevent nutritional deficiency anaemia.

Formatted: Font: (Default) Times New Roman, 12 pt, Not Bold, No underline

Formatted: Justified

Pregnant females being the most vulnerable group for nutritional deficiencies, require early screening for anaemia and associated illnesses.Initial screening and subsequent diagnostic test enable early diagnosis and appropriate management.Utilization of technologic advances is beneficial in arriving at a definite diagnosis.The basal blood parameters are mandatory before initiating treatment in women of child bearing anaemia cases.

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt

- In the present study ,microcytic hypochromic anaemia was found among 65.38% of women of reproductive age
- Microcytic hypochromic anaemia is commonly due to iron deficiency due to various reasons and most common is dietry .

Formatted: Font: 12 pt

Formatted: Font: 12 pt

- A uniform definition of screening criteria and an effective system to respond to abnormalities is the need of the hour.The present study was under taken ,keeping this need in view.

SUMMARY

The present study was undertaken from December 2020 to October ~~November~~ 2021~~,~~ in the Department of Pathology, Santosh Medical College and Hospitals, Ghaziabad.

Women of reproductive age patients between the ages of 15 years to 49 years~~, both~~ presenting to OPD and admitted to the pediatric, gynaecology~~,~~ or medicine ward of Santosh Hospital, Ghaziabad were included in the study.

- One hundred thirty patients diagnosed with anaemia as per the WHO criteria were studied.
- Among pregnant females,60.46% were found to have moderate anaemia.
- Among Non-pregnant females, 87.35% ~~were having~~had moderate anaemia

Formatted: Font: 18 pt, Bold
Formatted: Font: 12 pt
Formatted: Font: 12 pt
Formatted: List Paragraph, Justified, Bulleted + Level: 1 + Aligned at: 0.25" + Indent at: 0.5"
Formatted: Font: 12 pt
Formatted: Font: (Default) Times New Roman, 12 pt, Not Bold, No underline
Formatted: Justified, Indent: Left: 0", Right: 0", Space Before: 0 pt, Line spacing: Multiple 1.08 li
Formatted: Indent: Left: 0"
Formatted: Font: (Default) Times New Roman, 14 pt
Formatted: Indent: Left: 2"
Formatted: Justified

- Microcytic hypochromic anaemia was noted among 65.38% of women of reproductive age.

Formatted: Font: 18 pt, Bold

Formatted: Indent: Left: 0.25"

Formatted: Indent: Left: 0"

References

1. Gautam VP, Bansal Y, Taneja DK, Saha R, Shah B, Marg Z, et al. Prevalence of anaemia amongst pregnant women and its social and demographic associates in a rural area of Delhi. *IJCM. 2002; 27:157–60.*

2. De Maeyer E, Adiels-Tegmen M. The prevalence of anaemia in the world. *World health stat.1985*; 38:302-16

3.- Robbins, Cotran. Red blood cell and bleeding disorders. *8th ed. In: Pathologic Basis of Disease*, Vinay Kumar, Abdul K Abbas, Nelson Fausto, Jon C Aster, eds. Philadelphia: *Elsevier; 2010*. p.640.

4. Berman JD, Gilmer P. Improved classification of Anaemia by MCV and RDW. *American Journal of Clinical Pathology 1983;* 80:322.

5. Johnson CS, Tegos C, Beutler E. Thalassemia minor: Routine erythrocyte measurements and differentiation from iron deficiency. *Am J Clinical Pathology 1983* Jul; 80:31-6.

6. De Gruchy.The red cell:Basic aspects of anaemia,*5th ed.Inde Gruchy's Clinical Haematology in Medical Practice*,FrankFirkin,ColinChesterman, David Pennington,BryanRush,eds.GreatBritain:*BlackwellScienceLtd;1989*.p.17-36.

7.Demaeyer EM,DollamanP,GurneyJM,HallbergL,SoodSK. Preventing and controlling iron deficiency anaemia through primary health care.*Geneva: WorldHealthOrganization;1989*.p.26-36.

8.Y. Asres, T. Yemane, and L. Gedefaw, "Determinant factors of anaemia among non-pregnant women of childbearing age in southwest Ethiopia: a community-based study," *International Scholarly Research Notices, vol. 2014*, p.8.

9. S. Gebremedhin and F. Enquselassie, "Correlates of anaemia among women of reproductive age in Ethiopia: evidence from Ethiopian DHS 2005," *Ethiopian Journal of Health Development, vol. 25*, no. 1, 2011.6

10. Dreyfuss ML, Stoltzfus RJ, Shrestha JB, Pradhan EK, LeClerq SC, Khatry SK *et al*. Hookworms, malaria and vitamin A deficiency contribute to anaemia and iron deficiency among pregnant women in the plains of Nepal. *J Nutr 2000*; 130: 2527–2536.

11.A cross-sectional study of anaemia among women of reproductive age group (15-49 years) in a rural population of Tamil Nadu Chellavel Ganapathi K, Sathish Kumar K Department of Community Medicine, Government Mohan Kumara Mangalam Medical College, Salem, Tamil Nadu, India.

12. Verma R et al. Prevalence of anaemia in college going youths in rural block of a dist. of Northern India. *Indian Journal of Community Health 2014*; 26 (3).

Formatted: Font: 18 pt, Bold

Formatted: Font: 10 pt

Formatted: No Spacing, Line spacing: 1.5 lines

Formatted: Font: Italic

Formatted: Font: Italic

Formatted: Font: Italic

Formatted: Font: Italic

Formatted: Font: Italic

Formatted: Font: Italic

Formatted: Font: Italic

Formatted: Font: Italic

Formatted: Font: Italic

Comment [M47]: Correct all references as per Vancouver format

Formatted: Font: (Default) +Headings CS (Times New Roman), 12 pt, Italic

Formatted: Font: Italic

Formatted: Font: Italic

Formatted: Font: 12 pt

Formatted: Font: Italic

Formatted: No Spacing, Line spacing: 1.5 lines, Pattern: Clear

Formatted: Font: Italic

Formatted: No Spacing, Line spacing: 1.5 lines

Formatted: Font: Italic

13. Bulliyy G, Mallick G, Sethy GS, Kar SK. Haemoglobin status of non-school going adolescent girls in three districts of Orissa, *India. Int J Adolesc Med Health 2007*; 19:395-406

14.Berman JD, Gilmer P. Improved classification of Anaemia by MCV and RDW. *American Journal of Clinical Pathology1983*; 80:322.

15.Bain BJ,Lewis SM.Preparation and staining methods for blood and bone marrow films.*10th ed.Chapter4.In:Dacie and lewis practical haematology*,Mitchell S Lewis,Barbara J Bain,

16. Kish, Leslie. 1965. *Survey Sampling*. New York: John Wiley and Sons, Inc.

17. National family health survey 4, District fact sheet Ghaziabad UP.2015-

18.Anaemia prevalence in women of reproductive age in low- and middle-income countries between 2000 and 2018 Damaris Kinyoki, Aaron E. Osgood-Zimmerman, Natalia V. Bhattacharjee, Local Burden of Disease Anaemia Collaborators, Nicholas J. Kassebaum & Simon I. Hay.

19. Bhattacharjee, N. V. et al. Mapping exclusive breastfeeding in Africa between 2000 and 2017. *Nat. Med.* ***25***, 1205–1212 (2019).

20. Osgood-Zimmerman, A. et al. Mapping child growth failure in Africa between 2000 and 2015. *Nature* **555**, 41–47 (2018).

21. Kinyoki, D. K. et al. Mapping child growth failure across low- and middle-income countries. *Nature* **577**, 231–234 (2020).

22. World Health Organization. Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity. *https://www.who.int/vmnis/indicators/haemoglobin.pdf (2011).*

23.Mawani M, Ali SA, Bano G, Ali SA (2016) Iron Deficiency Anaemia among Women of Reproductive Age, an Important Public Health Problem: *Situation Analysis. Reprod Syst Sex Disord 5*: 187. doi:10.4172/2161-038X.1000187

24.- Milman N (2011) Anaemia—still a major health problem in many parts. *Ann Hematol 90*: 369-377.

25. Coad J, Conlon C (2011) Iron deficiency in women: assessment, causes and consequences. *Curr Opin Clin Nutr Metab Care 14*: 625-634.

26.http://web.worldbank.org/archive/website01213/WEB/0__CO-50.HTM.

27.- WHO (2008) Global anaemia prevalence and number of individuals affected.

28. Chulilla JAM, Colás MSR, Martín MG. Classification of anaemia for gastroenterologists. World *J Gastroenterol. 2009*;**15**(37):4627–37.

Formatted: Font: 18 pt, Bold
Formatted: Font: 12 pt
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: Italic
Comment [M48]: spacing
Formatted: Font: 12 pt
Formatted: Font: Italic
Formatted: No Spacing, Space After: 0 pt, Line spacing: 1.5 lines, Pattern: Clear
Formatted: Font: Font color: Accent 1
Formatted: Font: Font color: Accent 1
Formatted: Font: Font color: Accent 1
Formatted: Font: Font color: Accent 1
Formatted: Font: Font color: Accent 1
Formatted: Font: Font color: Accent 1
Formatted: French (France)
Formatted: No Spacing, Line spacing: 1.5 lines
Formatted: Font: Italic
Formatted: Font color: Text 1
Formatted: Default Paragraph Font, Font: Italic, Font color: Text 1, Pattern: Clear
Formatted: Font: 12 pt
Formatted: No Spacing, Right: 0", Space After: 0 pt, Line spacing: 1.5 lines, Pattern: Clear
Formatted: Font: 12 pt, Italic
Formatted: Font: 12 pt
Formatted: No Spacing, Line spacing: 1.5 lines
Formatted: Font: Italic
Formatted: Font: Italic
Comment [M49]: spacing
Formatted: Font color: Text 1
Formatted: Default Paragraph Font, Font color: Text 1
Formatted: Font: 12 pt, Font color: Text 1
Formatted: Font color: Text 1
Comment [M50]: check Vancouver format for reporting websites
Formatted: Portuguese (Brazil)
Formatted: Font: 12 pt
Formatted: Portuguese (Brazil)
Formatted: Font: Italic
Formatted: Font: Bold

29. Johnson CS, Tegos C, Beutler E. Thalassemia minor: Routine erythrocyte measurements and differentiation from iron deficiency. *Am J Clin Pathol 1983 Jul*; 80:31-6.

30. Oski FA. Iron deficiency in infancy and childhood. N Eng. *J Med 1993 July **15***; 329(3):190-3.

31. Kool IN Park, Kir Young Kim. Clinical evaluation of red cell volume distribution width (RDW). *Yonsei Medical Journal1987*;28(4):282-90.

32.The impact of maternal iron deficiency and iron deficiency anaemia on child's health Noran M. Abu-Ouf, MBChB, MSc and Mohammed M. Jan, MBChB, FRCPC

33. Anaemia in Pregnancy: ACOG Practice Bulletin, Number 233. *Obstetrics & Gynaecology: August 2021 - Volume 138* - Issue 2 - p e55-e64 doi: 10.1097/AOG.0000000000004477

34. Rappaport ES, Helbert B, Beissner RS, Trowbridge A. Automated haematology: Where we stand. *Southern Medical Journal1988*;81(3):365-70.

35. Elmardi, K.A., Adam, I., Malik, E.M. *et al.* Prevalence and determinants of anaemia in women of reproductive age in Sudan: analysis of a cross-sectional household survey. *BMC Public Health* **20**, 1125 (2020). https://doi.org/10.1186/s12889-020-09252-w

36. Perkins SL. Examination of the blood and bone marrow. 12th ed. In: *Wintrobe's Clinical Haematology,* John P Greer, John Foester, George M Rodgers, Frixos Paraskevas, Bertil Glader, Daniel A Arber, Robert T Means, eds. Philadelphia: *Lippincott Williams and Wilkins; 2009*. pp.1-20.

37. Anaemia and Thrombocytopenia in Pregnancy.Author: Fidelma B Rigby, MD; Chief Editor: Ronald M Ramus et al.

38. *Perkins SL. Examination of the blood and bone marrow. 12th ed.* In: *Wintrobe's Clinical Haematology*, John P Greer, John Foester, George M Rodgers, Frixos Paraskevas, Bertil Glader, Daniel A Arber, Robert T Means, eds. Philadelphia*: Lippincott Williams and Wilkins*; 2009. pp.1-20.

39. Bain BJ. Blood cell morphology in health and disease. 10th ed. In: *Dacie and Lewis Practical haematology*, Mitchell S Lewis, Barbara J Bain, Imelda Bates, eds. *Philadelphia: Churchill Livingstone; 2006*. pp.79-115.

40. Bain BJ, Lewis SM, Batis I. *Basic haematological techniques. 10th ed*. In: *Dacie and Lewis Practical haematology*, Mitchell S Lewis, Barbara J Bain, Imelda Bates, eds. *Philadelphia: Churchill Livingstone; 2006*. pp.25-59.

Formatted: Font: 18 pt, Bold
Formatted: Font: Italic
Formatted: Font: 12 pt
Formatted: Font: Italic
Formatted: Font: Bold, Italic
Formatted: Font: 12 pt
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Default Paragraph Font, Font color: Auto, Pattern: Clear
Formatted: Font: (Default) Times New Roman
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: (Default) Times New Roman, Font color: Text 1
Formatted: Font color: Text 1
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: Italic

41. Pagana Kathleen Deska, Timothy J Pagana. *Mosby's Manual of diagnostic and laboratory. 3rd ed.* Philadelphia: *Elsevier;2005.*

42. *Lewis SM. Reference ranges and normal values. 10th ed*. In: *Dacie and Lewis Practical haematology*, Mitchell S Lewis, Barbara J Bain, Imelda Bates, eds. *Philadelphia: Churchill Livingstone; 2006*. p.11.

43. Furkin F, Chisterman C, Penington D, Rush B. The red cell: *Basic aspects of anaemia. 5th ed*. In: *de Gruchy's Clinical Haematology in medical practice*. *Great Britain: Blackwell Scientific Publication; 1989*. pp.17-36.

44. Haroon Saloojee, John M Pettifor. Iron deficiency and impaired child development. *BMJ2001*;323: 1377-8.

45. Andrews NC. Iron deficiency and related disorders. In: Wintrobe's Clinical haematology, John P Greer, John Faersters, George M Rodgers, Frixos Paraskevas, Bertil Glader, eds. *Philadelphia: Lippincott Williams & Wilkins; 2009.* p.818.

46. Andrews NC, Ullrich CK, Fleming MD. Disorders of iron metabolism and sideroblastic anaemia. 7th ed. In: Natan and Oski's Haematology of infancy and childhood, David G Nathan, Sutart Horkin, David Ginsburg, Thomas A Look, David Fisber, eds. *Philadelphia: Elsevier; 2008.* pp.521-54.

47.Beutler E, Ganz T. Disorders of red cells. 7th ed. In*: William's Haematology*; Lichtman MA, Beutler E, Kipps TJ, Serigsohn U, Karshansky K, eds. USA: *McGraw-Hill Medical Publishing Division; 2006.* pp.511-55.

48. Furkin F, Chisterman C, Penington D, Rush B. The red cell: *Basic aspects of anaemia. 5th ed*. In: *deGruchy's Clinical haematology in medical practice*, Frank Firkin, Colin Chesterman, David Penington, Bryan Rush, eds. Great Britain*; Blackwell Scientific Publication; 1989*. pp.17-36.

49. Ashwani Kumar, Valicha N, Jain T, Dash AP. Burden of Malaria in India: Retrospective and prospective view. *Am J Trop Med 2007*;77(6):69-78.

50. White NJ, Breman JG. *Malaria. 17th ed. Chapter 203*. In: Harrison's Principles of Internal Medicine, Fauci, Braunwald, Kasper, Hauser, Longo, Jameson, et al. New York: *McGrawHill; 2008*. p. 1280.

51. Cook G, Zumla A. *Manson's Tropical diseases. 22nd ed. Elsevier*; 2009.

52. Segal GB*. Definition and classification of haemolyticanaemias. 18th ed*. In: *Nelson's Textbook of Paediatrics*, Robert M Kliegman, Richard E Behrman, Hal B Jenson, Banita F Stanton, eds. Philadelphia: Saunders, Elsevier; 2007. pp. 2018-21

Formatted: Font: 18 pt, Bold
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: 12 pt
Formatted: Font: 12 pt, Italic
Formatted: Font: 12 pt
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: 12 pt
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: Italic

53. Behrman RE, Kleigman RM. *Anaemia of chronic diseases and renal diseases.18th ed*. Chapter 451. In: Nelson's Textbook of Paediatrics, Robert M Kliegman, Richard E Behrman, Hal B Jenson, Banita F Stanton, eds. Philadelphia: *WB Saunders Co; 2007*. pp. 2008-9.

54.Blood W. XN-350 XN-350. i(40):25–6.

55.Nwogoh B, Transfusion B, State E, Transfusion B, State R. *Peripheral Blood Film*. 1974;12(2):71–9.

56. Immulite / Immulite 1000 Ferritin. *Operator's Manual; 2008*.

57. Patel A. H, Kharod Patel P. Study of anemia in hospitalised infants with special reference to its risk factors. Int J Pediatr Res.2019;6(10): 527 533. doi:10.17511/ijpr. 2019.i10.06.

58. Brotanck JM, Gosz J, Weitzman M, Flores G. Iron deficiency in early childhood in United States; Risk factors and racial/ethnic disparities. *Pediatrics 2007*; 120(3):568-75.

59. Prevalence of anaemia in pregnancy at booking: a *retrospective study at a tertiary care centre in Lucknow India* Asma Nigar 1*, Ausaf Ahmad

60. Mishra S, Gupta P, Bhardwaj P, Sachan B, Srivastava JP, Mishra AN. Effect of antenatal services during pregnancy on prevalence of anemia amongst pregnant women in Lucknow. *Indian J Med Sci. 2016*;68(1):48-51.

61. Vemulapalli B, Rao K. Prevalence of anemia among pregnant women of rural community in Vizianagram, North Coastal Andhra Pradesh, *India. Asian J Med Sciences. 2014*; 5:44-9.

62. Hyder, S., Persson, L., Chowdhury, A., & Ekström, E. (2001). Anaemia among non-pregnant women in rural Bangladesh. *Public Health Nutrition, 4*(1), 79-83. doi:10.1079/PHN200055

63.Factors associated with anaemia in a nationally representative sample of non-pregnant women of reproductive age in Nepal
Nicole D. Ford,Ram Padarth Bichha,Kedar Raj Parajuli,Naveen Paudyal,Nira Joshi,Ralph D. Whitehead Jr,Stanley Chitekwe,Zuguo Mei,Rafael Flores-Ayala …

64. Kamruzzaman, M., Rabbani, M.G., Saw, A. *et al.* Differentials in the prevalence of anemia among non-pregnant, ever-married women in Bangladesh: multilevel logistic regression analysis of data from the 2011 Bangladesh Demographic and Health Survey. *BMC Women's Health* **15**, 54 (2015). https://doi.org/10.1186/s12905-015-0211-4

Formatted: Font: 18 pt, Bold
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: 12 pt, Swedish (Sweden)
Formatted: Font: 12 pt
Formatted: Font: Italic
Formatted: Italian (Italy)
Formatted: Font: Italic, Italian (Italy)
Formatted: Italian (Italy)
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: Font: 12 pt
Formatted: Font: Italic
Formatted: Font: Italic
Formatted: No Spacing, Line spacing: 1.5 lines, Pattern: Clear
Formatted: Font: Border: : (No border)
Formatted: Font: Border: : (No border)
Formatted: Font: Border: : (No border)
Formatted: Font: Border: : (No border)
Formatted: Font: Border: : (No border)
Formatted: Font: Border: : (No border)
Formatted: Font: Border: : (No border)
Formatted: Font: Border: : (No border)
Formatted: Font: Border: : (No border)
Formatted: Font color: Text 1
Formatted: Font: 10 pt, Font color: Text 1

~~3~~

PROFORMA

Name: -Ip Number:

Age:

D.O.A: D.O.D:

Income:

Address: Socio economic status:

Informant:

Presenting complaints

Formatted: Font: 18 pt, Bold

Formatted: Font: (Default) Times New Roman

Formatted: Font: (Default) Times New Roman, 14 pt

Formatted: Font: (Default) Times New Roman, 14 pt

Formatted: Italian (Italy)

Formatted: Font: 18 pt, Bold

Loss of appetite	Weakness
Loss of weight	Vomiting
Cough	Fever
Puffiness of face	Others

History

Chronic illness

Blood transfusion

Infectious disease

Others:

Details of illness:

Clinical Diagnosis:

Investigations:

Hb%:	PCV:
MCV:	MCH:
MCHC:	RBC Count:
	TLC:
D.L.C:	

Formatted: Font: 18 pt, Bold

Platelet Count:

Peripheral smear:

Iron Studies:

Others:

STATISTICAL METHODS APPLIED

Formatted: Indent: Left: 1"

Statistical software used: IBM SPSS STATISTICS 27 version was used for the analysis of the data.

Statistical tests applied:

- **Descriptive statistics** like mean, percentage were used.

Formatted: Font: 18 pt, Bold

•**Chi-Square test of significance** The Chi-Square Test procedure tabulates a variable into categories and computes a chi-square statistic. This goodness-of-fit test compares the observed and expected frequencies in each category to test either that all categories contain the same proportion of values or that each category contains a user-specified proportion of values.

KEY TO MASTER CHART

AGE - Acute gastro-enteritis

AGN - Acute glomerulonephritis

ARTI - Acute respiratory tract infection

BM - Bone marrow

BT - Blood transfusion

DA - Dimorphic anaemia

IDA - Iron deficiency anaemia

MHA - Microcytic hypochromic anaemia

NHA - Normocytic hypochromic anaemia

NAD - Nothing abnormality detected

NC - Nothing contributory

NNA - Normocytic normochromic anaemia

TB - Tuberculosis

Formatted: Font: 18 pt, Bold

CONSENT FORM

I …….. aged..….. Years

R/o …….....……

am willing to participate in study entitled **"ROLE OF PAP SMEAR TO DETECT CYTOLOGICAL ABNORMALITIES IN CERVICAL LESIONS IN A TERTIARY**

CARE CENTRE", conducted in the Department of Pathology, Santosh Medical College and Hospital. I am also willing to return for follow up during the course of study. I hereby, give my consent for the participation in this study.

Signature of Doctor Signature/Thumb impression of patient

Name:

Address:

Phone:

Date:

Formatted: Font: 18 pt, Bold

रोगी का सहमति पत्र

मैं.....उम्र ··.....साल, ... का / की माता / पिता ;

निवासी.....

.....अपनी स्वेछा से चिकित्सीय अध्ययन में अपने पुत्र / पुत्री को सम्मिलित करने की सहमति प्रदान करता / करती हूं। मुझे सेवा प्रदान करने वाले चिकित्सक ने संतुष्टि की सीमा तक इस चिकित्सीय अध्ययन की प्रकृति व उद्देश्य भली भांति अवगत करा दिया है। मैं समय पर अपने पुत्र / पुत्री कि जांच के लिए सहमति देता / देती हूं।

चिकित्सक के हस्ताक्षर।

रोगी के माता/पिता के हस्ताक्षर

अथवा अंगूठे का निशान

नाम :

पता :

फ़ोन क्रमांक :

दिनांक :

Formatted: Font: 18 pt, Bold

Formatted: Font: 18 pt, Bold

Formatted: Font: 18 pt, Bold

Formatted: Font: 18 pt, Bold

Formatted: Font: 18 pt, Bold

Formatted: Font: 18 pt, Bold

Formatted: Font: 18 pt, Bold

Formatted: Font: 18 pt, Bold

Formatted: Font: 18 pt, Bold